SEPTEMBER, 1942

ORGANIC FINISHING

SECTION OF METAL FINISHING

CQUERING • ENAMELING • JAPANNING • PAINTING

LIKE THE FIGHTING MAN,

FINISH MUST BE FIT, TOO

THE fighting man must be the flower of his country's manhood, must be brought to high physical perfection, clothed, fed and armed with the best. Only thus can he deliver the punch that wins. And the finish that protects his weapons must be fit, too.

Finish for military equipment must be perfect right up to the end. That shell must fire at its highest efficiency; that glider or plywood plane must not be damaged by moisture; rust and corrosion must be fought as bitter enemies. That's why the Government sets such high standards for finish—his weapons must measure up to the fighting man, they must not fail at the crucial moment.

Zapon finishes for government work not only rigidly adhere to the specifications, they often exceed them. All down the finishing line, we must see to it that the finish does not fail.

ZAPON

REG. U. S. PAT. OFF.

ZAPON DIVISION · ATLAS POWDER COMPANY

Eastern Sales: Stamford, Conn. *Western Sales:* North Chicago, Ill.

INDUSTRIAL FINISHES

Section of

METAL FINISHING

Founded January, 1903
as Metal Industry

Publication Office
116 John Street, New York

ORGANIC FINISHING

SECTION OF METAL FINISHING

SEPTEMBER, 1942

CONTENTS

ARTICLES

Military Applications for Organic Finishes — By Thomas P. Cusack, Jr... 499

Evaluating Spray Operators — By William L. Mattern 507

DEPARTMENTS

News From Washington .. 498

Problems In Finishing 508

New Equipment and Supplies 513

Manufacturers' Literature . 514

Patents 514

Picture On Cover

The picture on the cover is shown through the courtesy of the DeVilbiss Company, Toledo, Ohio. It shows an installation at the Budd Wheel Company plant, Detroit, Michigan, the view being of the general painting line for all shells turned out by the Budd Company. A row of DeVilbiss rotary-type automatic spray machines for shells appears at the right, while the shell inspection bench is shown at the left.

Salvaging Finishing Materials

We note from a recent report that the Conservation Bureau of the War Production Board has estimated that 100,000,000 pounds of essential finishing material ingredients could be recovered from waste paints, enamels, lacquers, etc. in the next eighteen months. This estimate is based on replies from a large number of companies canvassed as to the possibility of salvaging waste finishing materials in the form of overspray, spray booth sludge. The report goes on to say that, "Aside from representing substantial savings of critical materials, an effective program of reclamation should mean great economy in the cost of painting our war machines."

Users of finishing materials must cooperate in this effort to reclaim and use waste finishing material. A hundred million pounds represents a tremendous amount of finishing material. By conservative calculation it is sufficient for the manufacture of more than six million gallons or, put another way, it is enough to provide one coat for more than a billion square feet of surface. With so much at stake it would be exceedingly short sighted, not to say unpatriotic, not to cooperate.

Reclamation of spray booth sludge and other waste finishing materials is not an untried scheme. It is an accomplished fact. Perfectly good and usable finishing materials have been made from reclaimed ingredients. At least one large manufacturer with which we are familiar found it profitable to use finishing material waste this way rather than to destroy it. His spray booth sludge was made into a perfectly good exterior paint and an amazingly effective metal primer. As for facilities for reclamation, the report states that there are now fourteen plants possessing reclaiming equipment and the capacity of these should be sufficient to handle the estimated quantity of reclaimable finishing material waste.

Investigate the possibility of reclaiming YOUR waste finishing materials.

L. H. LANGDON, *Publisher* • T. A. TRUMBOUR, *Business Manager* • DR. WALTER R. MEYER, *Editor*

NEWS FROM WASHINGTON—

A substantial reduction in the price of imported cresylic acid, a chemical used in the production of important military and civilian products, was announced July 31, by Price Administrator Henderson.

A specific price measure for this type of cresylic acid —Maximum Price Regulation No. 192, Imported Cresylic Acid—provides an elastic pricing formula which establishes the ceiling price for sales by importers at approximately $1.10 per gallon. This price, based upon current cost conditions, is from $.40 to $.75 under the maximum previously established for most importers by the general maximum price regulation. The new price schedule is effective August 5.

Three chemicals orders due to expire on July 31 were extended until revoked today by the Director General for Operations.

The orders are M-27, which directs the distribution of **phenols**; M-71, which directs the processing and distribution of **fats** and **oils**; and M-31, which governs the deliveries of **methyl alcohol.**

The Lead Pigment Manufacturers Advisory Committee appointed by the War Production Board are John Allegaert of United Color & Pigment Company of Newark, New Jersey; J. M. Bowlby of the Eagle-Pitcher Lead Company of Cincinnati, Ohio; Arthur F. Brown of the Imperial Paper and Color Corporation of Glens Falls, New York; F. O. Case of the Anaconda Copper Mining Company of Chicago, Illinois; S. B. Coolidge, Jr. of the Sherwin-Williams Company of Cleveland, Ohio; John R. MacGregor of John R. MacGregor Lead Company of Chicago, Illinois; C. H. Rupprecht of the Kreba Pigments Department of the E. I. DuPont de Nemours & Company of Wilmington, Delaware; Fletcher W. Rockwell of National Lead Company of New York City; P. E. Sprague of the Glidden Company of Cleveland, Ohio; William Wilke, Jr. of Hammond Lead Products Incorporated of Hammond, Indiana; and Erwin Vogelsang of the Tin and Lead Branch of the WPB.

The civilian use of shellac is practically stopped by Conservation Order M-106 as amended July 31st, 1942. Applications for use, processing or delivery of shellac must be made on Form PD-617.

For the first time in the history of Fire Prevention Week (October 4-10), the Federal Government will take an active part in its observance. The Office of Civilian Defense, Washington, D. C. will send to anyone a folder listing sources of educational material on ways and means of reducing the fire hazard.

The Varnish and Lacquer Association together with six learned societies are working with the Army Ordnance Department in an advisory capacity in solving important technical problems.

Soluble nitrocellulose was placed under distribution control by Order M-196 issued on August 6th, 1942. Special authorization must be obtained from the Director General for Operations of the WPB for deliveries of more than 1,000 pounds a month. "Deliveries of more than 232 pounds and less than 1,000 may be made without allocation, but with a certificate to the supplier that the soluble nitrocellulose is to be used to fill war orders, plus an amount in excess of 50 per cent of the average monthly consumption of the consumer in 1941." Requests for allocation must be made on Form PD-609; and monthly reports must be made on Form PD-610.

Phthalate plasticizers, used to make lacquers, were placed under complete allocation control by General Preference Order M-203 issued on August 1st, 1942. Persons who seek delivery of phthalate plasticizers must use Form PD-606; and producers and distributors must make monthly reports on Form PD-607.

Companies with stocks of toluene on hand and who have been granted authority by the War Production Board to release these stocks to certain producers have been requested to observe a maximum price of two cents (.02) per gallon plus the delivered cost of the toluene, the Office of Price Administration announced recently.

All stocks of toluene in the hands of persons who would normally have used such stocks as diluents in protective coatings were frozen under General Preference Order No. M-34 as of February 1-1942, until authorization for their disposal was given by the Director of Priorities. The Director has commenced releasing these stocks to such persons as producers of TNT and DNT.

The companies to whom this notice was sent, and their competitors, do not ordinarily sell toluene and, of course, sold no toluene during March, the base period for determining maximum prices under the General Maximum Price Regulation. Mr. Henderson stated that the request was sent because, in addition, the companies involved do not have a strictly comparable commodity for sale, which would make it difficult for them to determine a maximum price for the unusual disposal of their inventory at the instance of the War Production Board.

Shippers of carbon tetrachloride may charge a reasonable deposit on the steel drums in transporting their product, Price Administrator Leon Henderson recently ruled. The steel used in making these drums is not plentiful, the Price Administrator said, and it is believed that a deposit will encourage the return of empty drums and thus conserve steel.

Up to the present no additional charges for containers have been permitted when the maximum price for carbon tetrachloride was charged, as this price (established by Revised Price Schedule No. 79—Carbon Tetrachloride) included the cost of the drums.

Permission to add a reasonable deposit to the maximum price was contained in Amendment No. 2 to Revised Price Schedule No. 79, and becomes effective July 1, 1942.

The amendment provides that if the shipper charges a deposit, the sum of $1.25 (or $1.65 if delivery is completed in Washington, California or Oregon) for each drum on which a deposit is required must be deducted from the total maximum price for the shipment. This deduction is necessary, Mr. Henderson said, in order to prevent an increase in the maximum price of the carbon tetrachloride at the consumer level.

The freight charge for the return of the containers must be paid by the owner and the deposit refunded immediately upon the return of the drum in good condition, he said.

It is to be noted that there are no other exceptions and even direct military orders require WPB authorization.

. . . — V

Military Applications for Organic Finishes*

By THOMAS P. CUSACK, JR.

C. M. Hall Lamp Company, Detroit, Michigan

AMERICAN industry, now definitely on the offensive, is making great strides in meeting the requirements of our Military forces. Though industrialists are faced with insistent demands for speed and increased production, they must conserve and efficiently utilize labor, space, materials and power. This is particularly true in finishing departments where curing or baking of modern synthetic finishes has become an industrial bottleneck due to the limitations of conventional ovens.

It is quite generally recognized that any finish that can be baked at all, can be baked with infra-red radiation. It was formerly thought that there might be some special catalytic effect at work that would account for frequently very remarkable accelerations in baking time that resulted from using radiant heat lamps. However, a critical examination of the baking process will show that the reduction in baking time depends largely upon two factors, one a more rapid temperature acceleration within the work, and second, a selection of materials favoring higher working temperature. In common with most chemical reactions, an increase in baking temperature results in a decrease in reaction or baking time and, of course, the more rapidly the temperature is attained the less total time is required for the process.

The finishes best suited to the speeding up process are the coatings formulated with synthetic resins. The term "synthetic" as used in the protective coating industry is usually restricted to materials based upon alkyd, glycerol-phthalate, urea and phenolic type resins. They dry both by oxidation and polymerization, and are used in both air drying and baking enamels. Though synthetic enamels react most favorably to radiant heat baking, the process is not limited to such enamels. Radiant heat will also speed the evaporation of solvents from the lacquer type finishes and at the same time eliminate blushing difficulties. Oleoresinous finishes are prepared from natural drying oils and from various natural resins and synthetic resins. They may dry both by oxidation and polymerization. They are made in many varieties for both air drying and baking. In oleoresinous enamels, radiant heat promotes oxidation and at the same time accelerates any accompanying polymerization.

Most military finishes in common use today, both by the Army and the Navy, fall into two general classes—lacquers or synthetics. There are very few specifications which require oleoresinous vehicles, and when they are specified, it is because of the peculiar nature of their use. Since the great majority of military finishes are formulated with synthetic resins or are of a lacquer type, radiant heat equipment is ideally suited for their baking. A listing of the most common specifications and their uses accompanied with a comparison of the conventional baking cycle to the radiant heating cycle will clearly demonstrate this statement.

A comparison of the radiant heat drying schedules with conventional drying schedules emphasizes the importance of controlled heat density radiant equipment in this present emergency. If speed, space saving, safety and economy are to be the watch words of war production, then radiant heating holds the answer to many industrial problems.

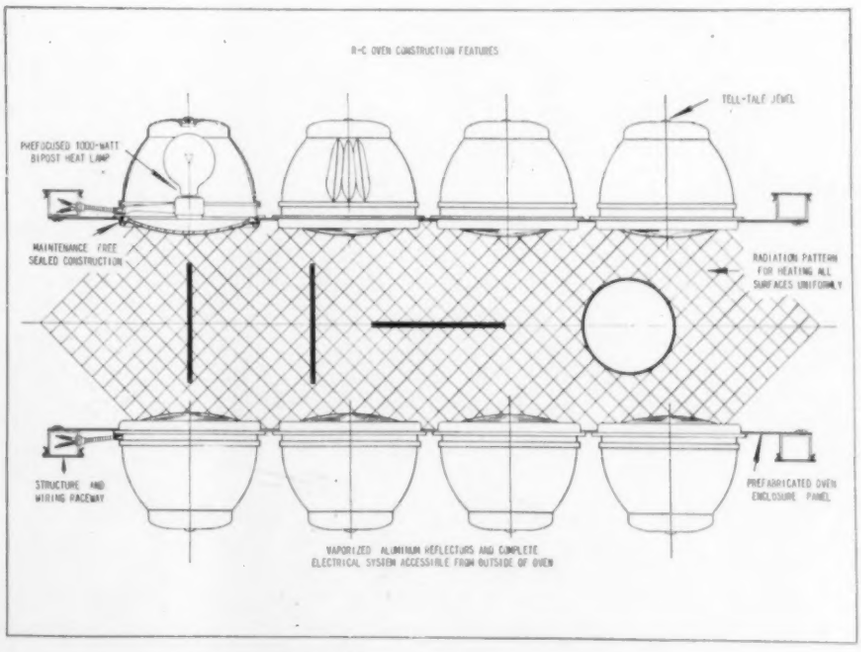

R-C OVEN CONSTRUCTION FEATURES
TELL-TALE JEWEL
PREFOCUSED 1000-WATT BIPOST HEAT LAMP
MAINTENANCE FREE SEALED CONSTRUCTION
RADIATION PATTERN FOR HEATING ALL SURFACES UNIFORMLY
STRUCTURE AND WIRING RACEWAY
PREFABRICATED OVEN ENCLOSURE PANEL
VAPORIZED ALUMINUM REFLECTORS AND COMPLETE ELECTRICAL SYSTEM ACCESSIBLE FROM OUTSIDE OF OVEN

Fig. 1. Schematic diagram showing oven cross-section and heat distribution.

*Presented at the Annual Meeting of American Electroplaters' Society held in Grand Rapids, June, 1942.

Drying Schedules for Convection and Radiation Drying of Commonly Used Finishes for Military Purposes

SPECIFICATION NO.	COATING	MAIN COMPONENT	USES	DRYING SCHEDULE Convection	Radiation
P X S 783	Zinc chromate primer	Glyceryl phthalate	Ammunition corrosion inhibitor. Corrosion inhibiting priming coat on metal structural parts.	1½ hr. @ 160°F	30 sec.—1½"
Army Air Corp. 14080	Zinc chromate metal primer	" "		10" @ 160°	30 sec.
Navy Aero, P-276-Z	Zinc chromate primer	" "	Corrosion inhibitor for use on aluminum alloys or steel.	1½ hr. @ 160°	20 sec.—1½"
QMC-ES 3596	Rust inhibiting primer	" "	Army vehicles, artillery components, tanks & misc. items.	30 min. @ 200°F	4½ min.
HQD-ES 680	Rust inhibiting primer	" "	Army vehicles, ordnance, artillery components, misc. items.	1 hr. @ 180°F	4½ min.
Army 3-162A	Lacquer for ammunition	Nitrocellulose	Protection and identification of ammunition.	15 min. @ 180°	30-40 sec.
Army 3-106E	Acid-proof black	Bituminous base	Inside coating on shells, bombs and land mines.	30 min. @ 180°	4½ min.
Army Air Corp. 14105	Camouflage lacquer	Nitrocellulose	Camouflage over primer.	10 min. @ 180°	30-40 sec.
Navy E 5 e	Aircraft enamel	Glyceryl phthalate	Exterior coatings for metal and fabric; also aircraft parts.	15 min. @ 300°	8 min.
Navy E 6 e	Black enamel	" "	Aircraft engine castings and instruments.	15 min. @ 300°	8 min.
QMC ES 4746	Lustreless olive drab	" "	Army vehicles, tanks, pontoons and artillery components.	1 hr. @ 250°	4½ min.
HQD ES 680	Lustreless olive drab	" "	Automotive products.	1 hr. @ 250°	4½ min.
ES 5106	Stenciling enamels	" "	Lettering on exposed surfaces.	30 min. @ 200°	3 min.
T 1103	Olive drab primer	" "	Portable landing mats.	1 hr. @ 300°F	5½ min.

Why Infra-Red Heating Is Different

Why does radiant heat fulfill the need? How does radiant heat work? How is it different from conventional baking methods? Why is it that baking cycles based on hot air temperature do not hold for radiant heating? For the answers to these often repeated questions let us examine the paint baking process and the mechanics of heating.

If you design a radiant heat oven and a conventional oven so that the time-temperature curve of the work is the same, and please note, that I say *time-temperature curve of the work itself*, little if any difference will be noticed between the baking effectiveness of the two ovens. If the temperature of the work is then increased in both systems, the baking time will decrease. In such a process, it will be observed that the effective curing of a protective coating is a matter of efficient heat transfer.

The transfer of heat from one body to another occurs in three ways—by convection, by conduction, by radiation or by any combination of the three. Conduction heating requires direct contact between the source of heat and the body to be heated. Convection employs a liquid or gaseous medium by means of which the heat is transferred from one body to another. While on the other hand, radiant heat requires no physical contact between two bodies or a material connecting link between them.

Convection Heating

Most industrial heat processes now rely on heat transfer by convection. In convection oven practice, heat transfer is directly proportional to the temperature difference existing between the working surface and the surrounding air. Air movement helps eliminate the insulating influence of gaseous films adjacent to the work and thus directly increases the heat transfer. The rate of transfer diminishes as the temperature of the work approaches that of the surrounding air, and when the state of equilibrium is reached, no further heat transfer is effected. The temperature rise is also influenced by the mass, conductivity and the specific heat of the material. With the intermediate heating of the air between the source and the point of useful work, two or more energy transfers result with consequent loss in speed of transfer and efficiency. The available radiant energy in a convection system is largely converted into convected heat by the heat transfer system before it is gainfully employed.

Infra-red Heating

Infra-red heat differs from other methods of heating primarily in that the energy is delivered directly from the source to the intended work. Infra-red energy is not manifest in the form of heat until it has been intercepted and absorbed in the material to be heated. Some materials will transmit these rays without converting them into heat. For example, infra-red will pass through air without heating the air to any appreciable extent; certain types of *glass* will transmit a high percentage of the infra-red rays. On the other hand, infra-red rays are stopped and absorbed by thin layers of water while other materials such as processed aluminum and bright virgin gold are excellent reflectors of infra-red energy.

In the transfer of radiant heat, the

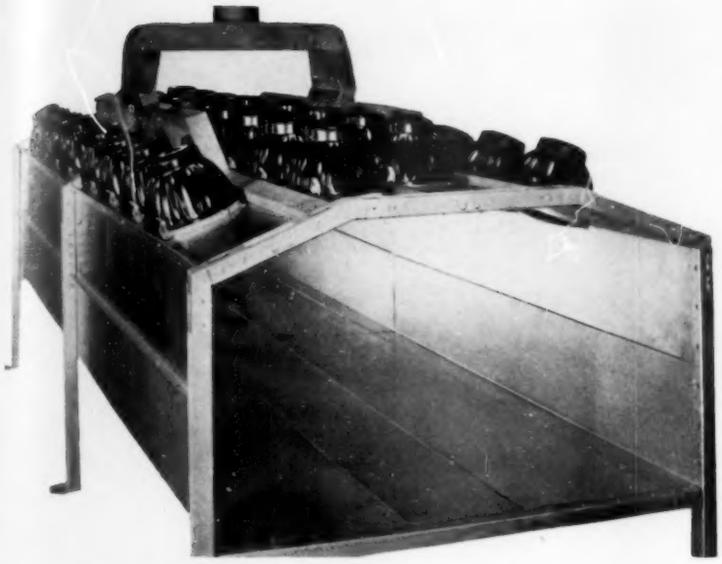


Fig. 2. Newest horizontal type enclosed double action (convection and radiation) oven used to bake zinc chromate on fabricated aluminum parts. Conveyor to be installed. Exhaust fan at top. All wiring and vital parts outside heating zone.

rate of temperature rise is directly dependent upon the ability of the surface to absorb the energy and the concentration or density of the energy received. Mass, specific heat and conductivity will affect the temperature rise and the uniformity of temperature within the material being heated. As in convection heating, however, the mean temperature attained is solely a matter of equilibrium, but in radiant heating this occurs when the rate of heat loss to the surrounding atmosphere is equivalent to the rate of energy input.

Air temperature which is not important in the original heat transfer becomes important because of its influence on losses. The heat losses to the air in general depend on the temperature difference between the surrounding air and the heated surface. Since radiant heating equipment is designed for a rapid rise of temperature and the maintaining of the temperature, any energy absorbed by the material in excess of the surrounding air temperature will be readily lost from the system by convection resulting in poor utilization of the otherwise effective electrical energy. The importance of elevated air temperature in radiant ovens thus becomes apparent. Maximum utilization of radiant energy is realized when the air temperature approaches the intended baking temperature. Subordinate surfaces not otherwise exposed to the radiant energy may thus be partially cured. At the same time a greater range of latitude is permitted between variations in mass, color, size and shape of product.

Retaining Convection Heat

Today the by-product, convection heat of a radiant heat oven, is retained by fully enclosing the entire system. A secondary ventilation system gainfully employs the derived warm air while at the same time assures the proper discharge of exhaust gases. With the combined use of radiation and convection, predetermined temperature cycles are most economically developed with multiple zone ovens. The most typical zone oven would be that for the baking of a normal synthetic enamel. In such an oven there would be four zones. The entering zone could be called a preheating section in which is employed the hot air taken from the radiant system. In this section there are no radiant heat sources. The preheating zone of a radiant-convection system would be used for a two-fold purpose, for the preheating of entering work with the hot air, thereby obtaining a greater overall thermal efficiency and at the same time to take off the high boiling volatile solvents.

The work would then enter a zone of high energy concentration in which 1000 watt radiant sources are employed. The use of high concentrations of radiant heat in this zone develops a rapid rise to the required baking temperature. From this high concentration of radiant energy, the work would enter a zone of low concentration. In this zone the low concentration is obtained by the proper spacing of similar 1000 watt lamps on wide centers. During this interval of low concentration, the previously attained temperature is held constant for any prescribed period of time. It is during this interval that the heat is evenly distributed through the mass by the thermal conductivity. This cycle may be short or prolonged as determined by the requirements of the coating.

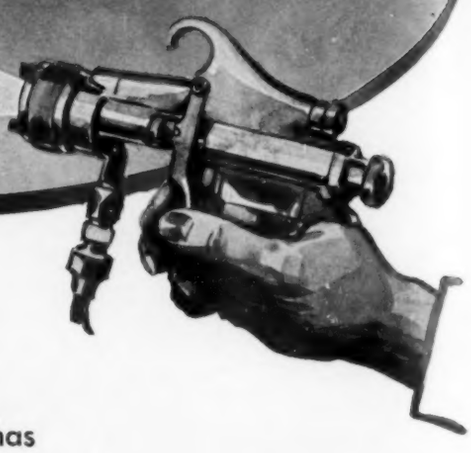
The work would leave the low concentration zone to enter what may be called a heat retention section in which there are no lamps. The heating cycle is completed during this period by the utilization of the derived convected heat and by the residual heat in the product itself. Although in this example we have spoken of but four different zones, each contributing to a prescribed baking cycle, it is quite possible to have any number of zones with variations in sequence, as, for example, in an oven specifically designed for baking wrinkle finishes, where to assure the most rapid formation and cure of the desired wrinkle finish, the high and low heating zones are reversed. No auxiliary instruments or temperature control equipment are necessary to maintain consistent results, although variations can be effected with voltage control or switching as desired.

Oven Design

The fact that a proposed manufacturing operation uses heat in some part of the process does allow the engineer to recommend any oven design indiscriminately. Radiant ovens like convection ovens should be designed to meet the paint specifications not the paint to the design of the oven. Of the many factors that the heating engineer will consider in determining what manner of heating is best suited for the process under consideration, the following are probably the most important: (1) Physical dimensions of the piece to be heated; (2) thermal characteristics of the material comprising the piece; (3) temperature requirements of the process; (4) time cycle requirements to effect completion of the process; (5) method of handling the product to assure essential space utilization; (6) safety consider-

"V-METALUSTRE"

FOR THOSE WHO MUST SIMULATE METAL FINISHES



THIS product of Maas & Waldstein research has been developed to meet the need for a non-metallic enamel that gives a lustrous metallic effect.

V-Metalustre is available in 10 colors, simulating various metal finishes. One coat is sufficient in most cases. . . . Air drying or baking is recommended.

We can make prompt shipment of V-Metalustre.

Send for complete information.

ARMAMENT MANUFACTURERS

A booklet of U. S. Government Specification Finishes is available to plant executives engaged in war production. Send for your copy.

M&W

Producers of Lacquers and Enamels

MAAS & WALDSTEIN COMPANY, NEWARK, N.J.

Branch Offices & Warehouses • 1658 CARROLL AVE., CHICAGO • 1228 W. PICO BLVD., LOS ANGELES

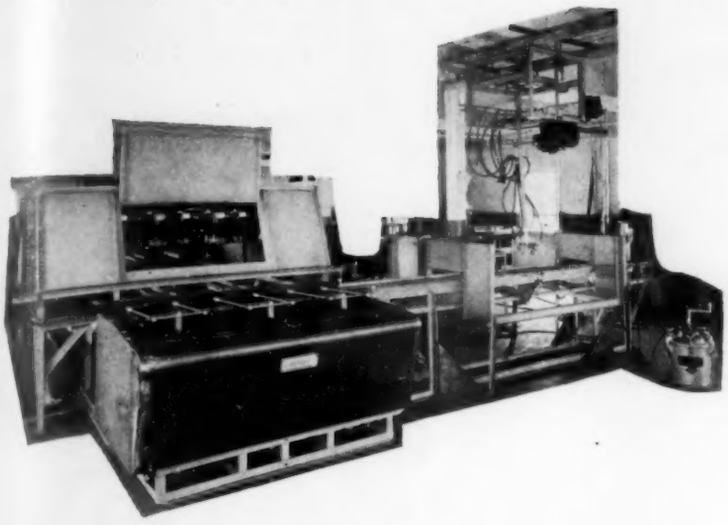


Fig. 3. High Speed Production in Compact Space.

Required: 15,000 linear feet per day.

Solution: Material automatically sprayed at high speed. As material approaches the infra-red oven, it is diverted in short length at a right angle and enters the oven at a reduced speed.

ations; (7) space limitations; (8) control and existing investment to be utilized. Long years of experience have taught furnace and oven manufacturers the necessity of acquiring sufficient data before ascertaining and recommending an oven for any manufacturing process. Radiant heating is no exception.

In the design of a radiant-convection system, much emphasis is placed on the judicious application of the infra-red sources and the utilization of the heated air. The same amount of consideration must be given to the arrangement and handling of the work parts to be heated. Since only that part of the energy which is intercepted and absorbed can be useful in raising the temperature of the work and in maintaining the temperature of the work, it follows that objects should present as much surface as possible to the lamps. This usually implies an engineered arrangement of the work on a conveyor line or on trays in a batch oven.

Open hanging centers should be avoided. Proper hangers should be designed for the handling of small parts. Formerly it was thought that items such as portable landing mats, small gun parts and window frames could not be finished and baked satisfactorily in a radiant heat oven. Now by properly hanging the parts in a well executed design of a radiant-convection oven, such open work is as efficiently baked as most general items.

In the application of radiant heat to insulating materials and to complicated shapes and irregular surfaces, there is the problem of uniform heat deliverance to all working surfaces so as to insure consistent and uniform temperature, and consequently uniform results. New optical principles have had to be introduced to avoid serious variations in heat density over a practical range of working distances within the oven. Employing such optical principles and by utilizing radiant and convected heat properly, it is now possible to bake the protective coating on any shape or size object in a well executed oven.

Advantages of Radiant-Convection Heat Equipment

Radiant-convection heat equipment presents several unique characteristics which are of prime importance in considering its use. In addition to its low initial investment and operating costs, there are several mechanical characteristics that affect the economy of this form of heating in a more indirect manner. These features include such items as the following: (1) No warm-up period, (2) greater coordination with other processes, (3) flexibility, (4) savings in floor space, (5) cleanliness, (6) consistency of results, and (7) the ability to observe the operation of the oven at all times. All these factors are at an advantage in a radiant-convection oven. Stand-by losses with this type of equipment are at an absolute minimum inasmuch as the oven need not be operated for any length of time prior to its intended service use. The ability of a radiant-convection type oven to respond instantly allows for greater coordination between the finishing room and other production processes. In the event of a short or a prolonged lag in production, the oven can be turned off, thereby saving costly fuel, and allowing work to remain in the oven without damaging results. This of course, is not true with conventional hot air equipment.

Wide Flexibility

By virtue of the simple construction involved, the flexibility of a radiant-convection type oven is unexcelled. Varying work temperatures may be had and maintained; varying baking cycles are possible by the proper circuiting of the electrical energy. The construction is so inexpensive that the manufacturer who must consider extraordinary changes in either items produced or the volume of production need have no qualms about changing the length or size of his radiant-convection oven with a change in his manufacturing procedure.

In some instances it is desirable to increase the production capacity of a conventional oven already in use. A radiant-convection oven is especially adapted to meet this problem of expansion because it can be fabricated in such a way as to supplement or complement present heating facilities. The ability to coordinate radiant-convection ovens with existing equipment has been used to advantage by many manufacturers. This particularly applies when consideration must be given to expenditures made for equipment to expedite the production of military items. Although radiant-convection equipment has proved its usefulness in this present emergency, it must be remembered that the same equipment can be used in normal times. Little or no change in equipment purchased for the production of military needs may be necessary.

Installations of radiant-convection ovens have permitted manufacturers to effect a greater production per dol-

lar of capital investment in oven equipment than with comparable convection equipment.

In almost every installation a savings in floor space has been accomplished by shorter cycles and proper arrangement of work on conveyor systems. Radiant-convection ovens have been designed to permit many passes of work within the oven. Wherever possible, radiant-convection ovens because of their light weight, have been suspended from the ceiling, thus releasing to the manufacturer floor space that was previously unavailable to him.

Safety Factors

Radiant-convection ovens are designed with the entire electrical system external to the oven. Wires are carried in covered channels to a central control panel. Complete control of the entire system in any desired sequence is made possible by interlocking devices. The conveyors, the ventilation system, the spraying operation and the heating are interlocked so that a failure at any point will stop the system, thereby preventing production losses and avoiding any unsafe conditions.

To further the interest of safety, all equipment used is of an approved type and is installed in accordance with the National Electric Code. Ovens are properly ventilated to remove the solvents in paint baking and to remove flammable dust and waste in drying and heating operations.

Uses of Radiant Heat

The most popular use for radiant heat is that of baking enamels on sheet metal. However, it must be noted that due to a saving in time, space and other costs, and due to cleanliness, safety and ease of control, radiant heating is today in common use for a great variety of applications where working temperatures need not exceed 500° F.

Case histories indicate that moisture drying with radiant heat has displayed advantages over other forms of heating in those cases where moisture is held on the surface or within a thin film of material. Finishes are being baked on heavy ordnance equipment with appreciable saving both in heating and cooling times. The heating of thermo-plastic sheet materials prior to forming has been quite successful. The melting of paraffin compounds on plated objects by means of radiant heat has become an accepted practice, as has the shrink fitting of gears and bearings. The baking cycle for insulating varnishes has also been substantially reduced, as, for example, on motor armatures and stators.

In short, three brief years have seen the commercial development of radiant heating carried to a point where it is now accepted as a full fledged tool of modern industry. Reflectors and lamps have given way to ovens and the challenge once presented by introduction of synthetic finishes is now returned by the electrical industry in a form which no production executive can afford to overlook. For war time demands as well as for peace time production, infra-red heating, in its most modern form, will surpass your fondest expectations with its performance and economy.

IRCO-IZING PROCESS

A CHEMICAL DIP TREATMENT FOR IRON, STEEL, ZINC & CADMIUM . . . PROVIDING A RUST INHIBITING BASE FOR PAINT OR A FINAL FINISH . . .

If you are contemplating, or in defense work now, and are faced with the problem of rustproof surfaces, whether a paint base or an oil finish . . . you will need the IRCO-IZING PROCESS!

- THE ONLY EQUIPMENT NEEDED ARE **TWO ORDINARY STEEL TANKS**
- FULLY MEETS GOVERNMENT RUSTPROOF SPECIFICATIONS

(IRCO ZINC COAT) + (100 PARTS WATER) & (WATER RINSE) = PAINT BASE or FINAL FINISH

In order for you to become entirely acquainted with the IRCO-IZING PROCESS we will be happy to treat samples of your production without obligation in our laboratory and return them to you for examination and test.

INTERNATIONAL RUSTPROOF CORPORATION

CORROSION SPECIALISTS

12507-15 PLOVER AVENUE CLEVELAND, OHIO

TROMEX resists breakdown because it contains specially-developed, new stabilizing inhibitors *that prevent acid formation* (rather than neutralize acid after it has formed). These improved inhibitors are themselves not affected by acids in cutting oils.

With TROMEX in your degreasing machines, work is delivered to the plating or finishing rooms chemically clean . . . right down into the pores of the metal, parts are completely oil and grease-free.

TROMEX works equally well on aluminum, magnesium and heavyweight metals. Our jobbers will gladly advise on the availability of stocks for use in essential industries.

Westvaco
CHEMICALS

WESTVACO CHLORINE PRODUCTS CORPORATION

405 LEXINGTON AVENUE • NEW YORK, N. Y.

YOU WILL NEED

the

APPROVED

WAR FINISHES

PAYSON—Approved at Holabird for the baked and air-dried paint and enamel finishes you will be using—

Specialists in

★ WRINKLE FINISHES ★

. . . Olive Drab . . . Black . . . etc.

. . . White Synthetics

. . . All Specification Paints

It Pays To Patronize a Specialist

WRITE, WIRE OR PHONE

PAYSON PAINT & VARNISH CORP.

804 EAST 141st STREET NEW YORK, N. Y.

Phone: MElrose 5-4920

Speed Your Drying! . . . Use a

KREIDER *Centrifugal Dryer*

for faster, lower cost drying of plated parts

A high speed, one-man drying outfit that will speed production and at the same time improve quality. May also be used for lacquering small parts. Sturdy all steel, electric welded construction. Foolproof controls include foot brake and reversing drum. V-belt drive; anti-friction bearings. Auxiliary heating unit available.

Write for complete information and prices.

DELLINGER MANUFACTURING CO.

727 North Prince St., Lancaster, Penna.

Some OLD CUSTOMS ARE GRAND!

That Saturday night scrubbing in the old tub was a grand old custom . . before the days of modern tubs and showers!

Against the hazards of INDUSTRIAL DERMATITIS, some plants stick to old-fashioned customs . . . . like the use of antiseptic oils in cutting compounds. Modern science has shown that they can't do the job COMPLETELY!

PLY Liquids and Creams—with a specific formula for each type of hazard—have proved their worth in the nation's leading industries. Pre-work application to the hands prevents irritation and often serious infection. PLY is harmless, easy-to-use, economical.

• Write TODAY for latest FREE BOOKLET "The Answer to Industrial Dermatitis"

PIONEERS OF SKIN PROTECTION IN INDUSTRY

PLY

The MILBURN Co.

Detroit • Michigan

Bayonets
Searchlights
Helmets
Rifle Parts
Shells & Cases
Land Mines
Fuses
Mess Kits
Motor Parts
Planes Parts
Sub-Assemblies
tings

WASHING MACHINES

Tailor Made and Custom Built to Solve Your Specific Metal Cleaning Problems

•

Let Us Quote on Your Current Needs

•

WASHING MACHINE DIVISION

MAGNUS CHEMICAL COMPANY

111 South Ave. Garwood N. J.

A MAGNUS PRODUCT

Plating and Finishing Guidebook

1942 EDITION

Edited by

DR. WALTER R. MEYER

The composite efforts of 25 experts in the plating and finishing industry.

New Sections. *Complete Revision.*

YOUR SUBSCRIPTION TO METAL FINISHING WILL BRING YOU, FREE, THIS AUTHORITATIVE AND MODERN BOOK.

Evaluating Spray Operators

By WILLIAM L. MATTERN

New York, N. Y.

A modification of the method for evaluating spray operator ability which appeared in the Organic Finishing Section is discussed by the author. This modification is based on the weight rather than the volume of finishing material which is applied and is of special interest where small irregularly shaped articles are finished.—Ed.

SOME time ago[1] there appeared a description of a method for evaluating the ability of spray operators based on the utilization of time and finishing material. Among the data employed in deriving the equations were the area of the piece being finished and the thickness of the cured film of finishing material on the finished piece. For many applications where the finished area and the thickness of the cured film may be accurately measured, the method is of particular value. There are instances, however, where area and thickness measurements are not so easily made as, for example, in the case of irregularly shaped pieces. In such cases it is possible to use the general method described in the original article if weight measurements are substituted for area and thickness measurements.

In the following it is shown how weight measurements are used in the equations for determining sprayer ability. The form of the original article is followed as closely as possible to allow comparison and except where new data are used the nomenclature remains the same.

Labor Utilization Factor

The labor utilization factor is the ratio of the amount of finishing material which is actually sprayed to the amount that could be sprayed in the same time if the spray gun were in constant wide-open operation. That is,

$$Lu = \frac{Wa}{Wp} \qquad \text{Eq. (1)}$$

where: Lu = labor utilization factor
Wa = actual weight of finishing material sprayed per time unit ..... pounds
Wp = possible weight of finishing material sprayed per time unit ..... pounds

For example, an operator uses 6.0 pounds of finishing material per hour (Wa). However, at the adjustment used, the gun can deliver 10.0 pounds per hour if kept in wide-open operation (Wp). It is obvious, therefore, that only sixty per cent of the hour was used in actual spraying. The labor utilization as calculated from Equation (1) is, then, Lu = $\frac{6.0}{10.0} = 0.6$.

Material Utilization Factor

This factor is a ratio of the amount of finishing material which is actually applied to the work to the amount that is sprayed from the gun. It may be expressed as follows:

$$Mu = \frac{(W)\ (N)}{(Wa)\ (Ps)}\ (100) \qquad \text{Eq. (2)}$$

where: Mu = material utilization factor
W = weight of cured finishing material per finished piece ..... pounds
N = number of pieces finished per time unit
Wa = (as above)
Ps = per cent by weight of non-volatiles in finishing material
100 = constant

For example, an operator sprays 6.0 pounds of finishing material per hour (Wa) in finishing 450 pieces (N). The finishing material contains 50.0 per cent by weight of non-volatile solids (Ps). The weight of cured finishing material on each piece is 0.003 pound (W). (This datum is the difference in weight of the piece before and after finishing. It is understood, of course, that if the weight of the piece being finished is large in comparison with the weight of the finishing material applied to it, difficulties may be encountered.) Substituting these data in Equation (2) it will be seen that

$$Mu = \frac{(0.003)\ (450)}{(6.0)\ (50.0)}\ (100) = 0.45.$$

Productivity Factor

The productivity factor, designated as (P), is the product of the labor utilization factor (Lu) and the material utilization factor (Mu), thus,

$$P = (Lu)\ (Mu) \qquad \text{Eq. (3)}$$

whence, by substituting Equations (1) and (2) in Equation (3),

$$P = \frac{(W)\ (N)}{(Wp)\ (Ps)}\ (100) \qquad \text{Eq. (4)}$$

which corresponds to Equation (5) in the original discussion.

The productivity factor of the operator described in the examples above may be calculated using the data given in Equation (4) or by determining (Lu) and (Mu) separately and then multiplying them as in Equation (3). In either case it will be found that the productivity factor of the sprayer under consideration is 0.27.

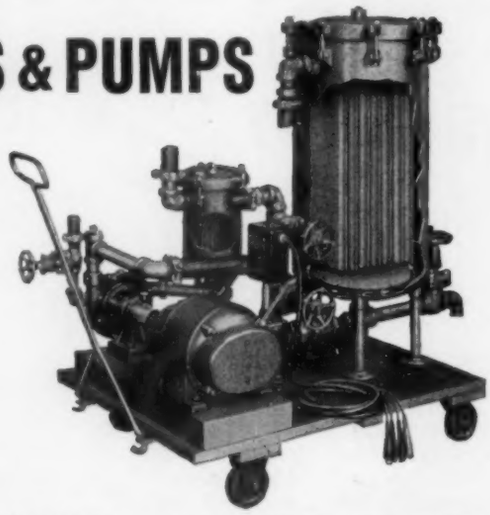
It is interesting to note that the quantity (Wa) cancels out and does not appear in Equation (4). This is an important factor in that no direct measurements on the operator are necessary.

Measurement of Material Used

In connection with the quantities of finishing material actually and possibly sprayed, it will be noted that the pound is used as the unit of measure-

1. METAL INDUSTRY, **37**, No. 10, 1939, (pp. 2, 3, Organic Finishing Supplement)

FILTERS & PUMPS



For Filtering, Pumping, or Circulating:—

ELECTROPLATING SOLUTIONS
DEGREASING SOLVENTS
CLEANERS
OILS
COOLANTS
LACQUERS
KERESENE
VARNISH
ALCOHOL & OTHERS

We carry a large stock of Filter & Pump accessories, hose, valves, fittings. All grades of filter cloth, filter aids, & FILTERBESTOS. Ready for shipment.

SALT SPRAY

CORROSION TEST EQUIPMENT

Designed to determine the corrosion resisting qualities of plated or coated metal, alloys, metal parts, organic finishes, etc. This equipment combines necessary features so that Salt Spray tests can be conducted to specifications at Controlled Temperatures to 130 Deg. Fah.

"Write for New Literature and Particulars"

INDUSTRIAL FILTER & PUMP MFG. CO.

3017 WEST CARROLL AVENUE CHICAGO, ILLINOIS

NICKEL FINISH

These two Substitute Metallic Finishes Now Standard in Many Industries Today

MEARLMAID PEARL ESSENCE OVER BLACK

MEARLMAID PEARL ESSENCE

BRONZE PLATING

MEARLMAID PEARL ESSENCE OVER BROWN

No Priorities Required — **Available In Unlimited Quantities**

THE MEARL CORPORATION

153 Waverly Place New York, N. Y.

ment. If for any reason it is desired to measure these quantities by volume rather than weight, Equation (1) becomes:

$$Lu = \frac{Va}{Vp} \qquad \text{Eq. (1a)}$$

where: Lu = (as above)
Va = actual volume of finishing material sprayed per time unit ____ gallons
Vp = possible volume of finishing material sprayed per time unit ____ gallons

and Equation (2) must be slightly modified by introducing the weight per gallon of finishing material into the denominator in order to change gallons to pounds, thus:

$$Mu = \frac{(W)\ (N)}{(Va)\ (D)\ (Ps)}(100) \qquad \text{Eq. (2a)}$$

where: D = weight per gallon of finishing material ____ pounds and all other nomenclature is as above.

Equation (4) then becomes:

$$P = \frac{(W)\ (N)}{(Vp)\ (D)\ (Ps)}(100) \qquad \text{Eq. (4a)}$$

*Problems in Finishing**

Problem 1. Thinning Ratios

Tests made on a baking enamel show that a thinning ratio of four parts by weight of enamel to one part by weight of thinner is necessary to obtain a consistency suitable for application. However, for cost and purchasing purposes, it is desirable to know the thinning ratio on a volume basis. If the specific gravity of the enamel is 1.2 and that of the thinner is 0.84, how many gallons of thinner must be purchased for use with each 55 gallon drum of enamel.

Solution: It is first necessary to determine the weight per gallon of the enamel and of the thinner. The weight of one gallon of any material is obtained by multiplying the specific gravity of that material by the constant 8.33. Thus, the weight per gallon of

*Editor's Note: This is the first of a series of problems which may be met in any typical finishing room. The editor will be pleased to receive problems for which solutions are desired. Next month the problem will deal with the cost of solids in thinned and unthinned finishing materials.

the enamel under consideration is $12 \times 8.33 = 10$ pounds. And the weight per gallon of the thinner is $0.84 \times 8.33 = 7$ pounds.

Now, since the weight ratio of the enamel to the thinner is 4 to 1, one gallon of the enamel (weight 10 pounds) will require $10 \times \frac{1}{4} = 2.5$ pounds of thinner or $2.5/7 = 0.357$ gallon of thinner. Whence, for each 55 gallon drum of enamel, $55 \times 0.357 = 19.7$ gallons of thinner are required.

Japans as Substitute for Baking Enamels

Question. Will you be so kind as to give us the benefit of your experience in advising us of the relative merits of black japan and black synthetic baking enamel? We have been using a black synthetic baking enamel for a number of years with considerable success. However, it appears that, because of a probable shortage of some of the ingredients, we may not be able to secure this material. Could we use a black baking japan? Is a japan as good as a synthetic?

Answer. Without complete details it would be difficult to say if your needs could be filled with a black baking japan. (Incidentally, the bituminous finishing materials known as japans have absolutely no connection with the nation with which we are at war. We know that you will have no objection if we use the term bituminous finishing material henceforth.) It can, however, be definitely stated that bituminous finishing materials, properly made and applied, possess many desirable characteristics. These materials have been and are used in considerable amounts. True, they have been somewhat overshadowed by air-drying lacquers and short-bake synthetic enamels. Still, they do have merit and, in addition to being made of many domestic ingredients, are usually moderately priced. We believe that you should contact your supplier, who knows your particular requirements, and request samples of bituminous finishing materials for you to test. In the event that he is not able to do this, he can undoubtedly refer you to some manufacturer who does make this type of finishing material.

Copper Sulfate Breakdown Test

Question. In a recent group discussion on testing finishes, one of those participating mentioned having heard that the copper sulfate immersion test occasionally fails on certain finishes in that a layer of copper deposits over the whole surface of the finish as soon as the test piece is placed in the solution. As you know, one of the advantages of this particular test is that wherever the acid solution causes film breakdown and exposes the bare metal, a deposit of copper occurs which plainly shows the place and extent of the finish failure. Is it possible that copper from the solution could deposit on the surface of the finish? If so, what type or types of finishes react this way and what is the reason?

Answer. The situation you describe is an odd one and has not come to our attention before. The answer may be one of chemical displacement involving pigments, or metallic driers used in finishing materials, or both. Possibly some of our readers have had experience with such plating out of copper on organic finish films during the copper sulfate test. Communications will be welcomed.

Perm-A-Clor THE MOST HIGHLY STABILIZED SAFETY SOLVENT

★ Efficient, low cost degreasing is always assured when Perm-A-Clor is used as the solvent.

Perm-A-Clor is much more stable, both as a liquid and as a vapor, than ordinary solvents. Its resistance to decomposition by heat, or in the presence of metals or moisture is so high that it may be reused indefinitely.

It is extremely economical, since only small additions of solvent are required to compensate for natural vapor loss. It is a non-flammable chlorinated safety solvent.

A Detrex engineer will gladly acquaint you with the advantages of Perm-A-Clor for your degreasing operations . . . no obligation, of course.

SOLVENT DEGREASING and ALKALI CLEANING

DETROIT REX PRODUCTS COMPANY

13099 HILLVIEW AVENUE • DETROIT, MICHIGAN

Branch Offices In Principal Cities of U. S. A. — In Canada: Canadian Hanson & Van Winkle Co., Ltd., Toronto, Ontario

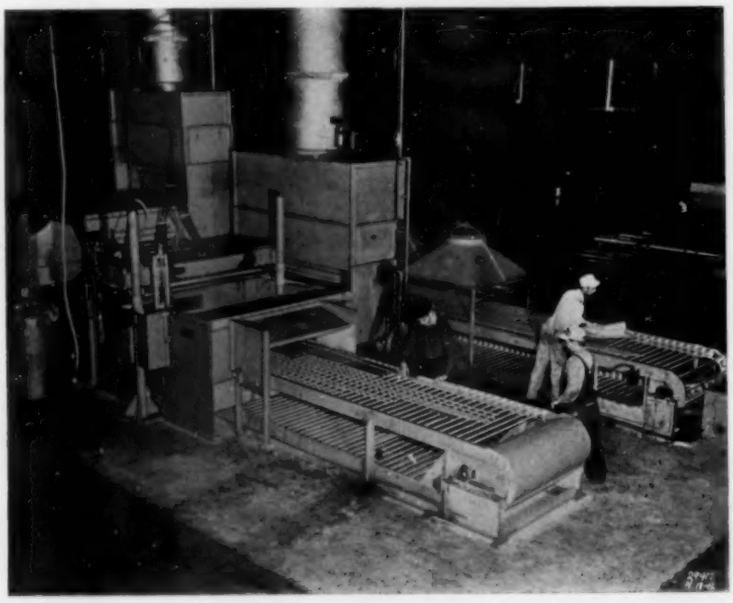
Automatic Spraying of Bomber Parts

A robot painter that sprays automatically the multitude of parts that comprise Martin bombers has been installed by The Glenn L. Martin Company of Baltimore. Operated by five men, it is stated that the device does in a third of the time the work that formerly required fifteen men to do. Ten men, badly needed for other work, thus are released from hand-operated spray guns.

Made for the Martin company by a spray-gun manufacturer, numerous refinements and improvements have been added to adapt the machine to aircraft work. One such improvement is the stack and ventilator arrangement which keeps fine particles of paint from being drawn out through the stack into the air over the roof of the building. In the past, the fine paint "dust" presented a fire hazard. Today, the excess paint spray is filtered through a veritable waterfall and is collected in a big tank under the paint racks, later to be skimmed off with ladles.

Other changes in the machine brought about by Martin engineers include the addition of two hand-spray booths on each cycle of the machine, changes in the drying oven and various improvements which were found necessary.

The machine itself is in two banks, or cycles, and works on the endless belt system. Small parts that have first been cleaned and anodized are brought in baskets on the overhead chain conveyor system to a station near the robot paint sprayer. These parts are of various shapes and sizes; some of them slated to go into Navy patrol bombers, others into the construction of bombers for the Army and the British.



Parts, painted on one side, are started on a duplicate of their first trip down the line. When they reach the end of the second phase in the robot spraying process, they will be completely covered with a protective coat of corrosion-resistant paint.

Taken from the baskets, the pieces are started on their journey through the robot sprayer. Placed on the cross-bars of the endless belt, they are first carried under a set of over-head spray guns that whip back and forth across the moving pieces. As the belt moves on, the parts are carried through an oven equipped with infra-red lamps designed to speed the drying process, and then through a second drying unit where numerous fans force warm air on the parts.

The infra-red lamps are so arranged that they may be turned on in units of four or more, depending upon the type of paint being used at the time. If the paint drys rapidly of its own accord, it is not necessary to use the lamps at all; if the paint is a slow dryer, then the lamps are turned on. This infra-red oven also makes it possible to increase the speed of the machine when desirable.

The numerous parts, after having passed through the ovens, now completely dry and painted on one side, are taken from the conveyor which comprises the first cycle of the operation, turned over and placed on the other conveyor which travels in the opposite direction. Thus, the second cycle in the operation, a duplicate of the first, is started. When the pieces have reached the end of the second cycle, they are completely covered with a primary coat of anti-acid paint which is designed to eliminate so far as possible the action of corrosive elements on the metal.

The company reports that the whole process, from the time the parts are started on their way through the machine until they have been removed and sent on to finished parts stock or the assembly line, takes about fifteen minutes.

The Buy-Word Is "Enthone" for ENAMEL STRIPPERS

For the past 4 years Enthone strippers have been used by hundreds of manufacturers for quickly removing organic finishes from civilian goods.

And NOW—fast working, patented* Enthone strippers are helping to speed the flow of war goods.

Here's what Enthone strippers do:

★ Strip synthetics, japans, lacquers rapidly.
★ Leave all metals clean and bright.

SPECIAL STRIPPERS for SPECIAL PROBLEMS — TELL US YOUR PROBLEM!

THE Enthone CO.
NEW HAVEN, CONN.

*Protected by U.S Patent No 2242106

WASHING MACHINES

SPEED PRODUCTION • REDUCE COSTS • BETTER CLEANING

For All Your Special Problems
Designed by Experts
Built in a Modern, Fully Equipped Plant

Let Us Quote on Your Current Needs

WASHING MACHINE DIV.
MAGNUS CHEMICAL COMPANY
111 South Ave. Garwood, N. J.

A Magnus PRODUCT

NEW EQUIPMENT AND SUPPLIES

LATEST COMMERCIAL DEVELOPMENTS IN ORGANIC FINISHING

Wax-Free Paint Remover

Turco Products, Inc., Box 2649 Terminal Annex, Los Angeles, Cal., have announced a new non-inflammable wax-free paint remover called "Turco Stripper L-595".

It is stated that this remover will not injure polished aluminum, cadmium plated steel, copper or other metals. The cleaner is claimed not to contain wax and because of its non-inflammability, is safe to use near machines giving off sparks, such as electrical apparatus or grinding wheels. No after cleaning is said to be necessary because of the absence of the wax film.

The stripper is used undiluted and can be applied to the surface to be stripped by painting, dipping or spraying. It is recommended for removal of varnish, lacquer, enamels and animal or casein glues. The loosened paint or other organic coating can be removed with an air gun, brush or by other mechanical means.

Paint Soon to be Packed in Paper Cans

Paper paint cans are the latest contribution of The Sherwin-Williams Co., world's largest manufacturers of paints and varnishes, to the war conservation drive. The top and bottom of the new container, which is the result of several months of experimentation at the company's Chicago Plant, are metal discs, but the body is made entirely of cardboard impregnated with an insoluble substance.

No tin at all is required. In fact, according to H. J. Hain, Vice-President who was in charge of the project to develop a "war emergency container", The Sherwin-Williams Co. restricted the use of tin plate several years ago when engineers at its Chicago Can Plant found that alloy coated plate made just as good paint cans as tin plate.

This alloy coated plate is now being used for the metal ends of the new container, but further experiments are already underway which, it is hoped, will result in the complete elimination of alloy plate and permit the metal discs to be made from lacquered black plate.

Cardboard containers for paints.

The biggest problem in developing the paper paint can was finding a method of moisture-proofing the cardboard. The common ice cream container could not be used because it would soak up the oils and solvents in paint, resulting in a soggy can and deteriorated contents. This obstacle was overcome by chemically treating the cardboard and placing an impregnated paper lining inside the can to prevent "wicking" or absorption.

According to Mr. Hain, the company does not claim that the new substitute is just as good as an all-metal container. A new label carries the line—"War Emergency Container—Handle with Care". However, the paper can has been tested extensively for wicking, for evaporation, and for shipping and storage qualities, and in each respect it has proved completely satisfactory.

Inside diameter of the new container, now in production in the quart size, is slightly less than the all-metal can because the walls are thicker. The height has been increased to allow for the change in diameter and for the generous "bite" with which the ends clamp the paper body. In addition to quarts, a half-pint and a gallon size will also be manufactured.

Another metal conservation measure recently introduced by Sherwin-Williams is the placing of a billing charge to the customer on large metal drums and a refund when returned to insure their quick return when empty. When returned, the drums are scoured with a caustic solution, spray-finished, and put back into use. This process can be repeated over and over again.

As a result of these and other conservation measures, The Sherwin-Williams Co. will now be able to get along with less than half as much metal plate as it used for containers in 1940. The remainder will be released for war production.

Substitute for Paint Cup

Binks Mfg. Co., 3114-40 Carroll Ave., Chicago, Ill., have announced the development of their "L-367 Can Adapter", which makes use of the original paint container, as the paint cup on the gun.

This device fits onto the standard cup attachment for spray guns and can be used for any standard type paint can, according to the manufacturer.

A limited supply of these adapters is available without any priority rating, and they will be furnished on a "first come-first served" basis as long as the supply lasts.

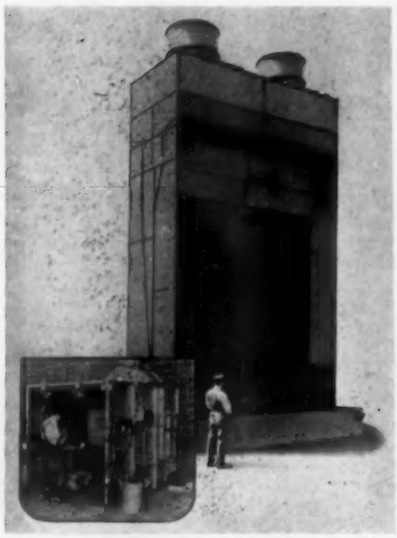
Illustration showing how adapter is used with paint can.

World's Biggest Spray Booth—for Bombers

Soon, in one of the big aircraft plants, the world's largest water wash spray booth will be in operation. It will be 152 feet long, 100 feet deep and 31 feet high and was designed and built by The DeVilbiss Co., Toledo, Ohio for painting large bomber parts and complete planes.

The illustration above, shows one of the eight compartments that will be assembled into the mammoth installation, as compared to the size of an ordinary industrial spray booth. These compartments will be assembled in pairs, side by side, with an intervening six foot space between pairs to accommodate motor-driven accordion partitions—31 feet high and having a 100 foot span. Folding partitions are also mounted on the ends.

The booth's design has several advantages. Because of its sectional construction and folding partitions, it can be used as one enormous spray booth with 15,200 square feet floor space or can be cut into two, three or four booths, each large enough to accommodate a bomber's fuselage less its wing surfaces. The maximum booth space will



Large water-wash spray booth for finishing bombers.

permit a complete large size bomber to be wheeled in for painting.

There are many interesting angles in the remarkable efficiency of the exhausting facilities of this equipment.

The wash down curtain in each compartment shown above is 20 feet high and water cascades over it at the rate of 24,000 gallons per hour. That means a water fall of 192,000 gallons an hour for the complete installation—a virtual Niagara. Air is drawn through the curtain of water in each compartment by two fans—each 48 inches in diameter and each driven by a 7½ H.P. motor—developing a capacity of 31,000 cubic feet of air per minute for each water wash compartment. Thus 62,000 cubic feet of air per minute is drawn through each of the eight sections. With the entire installation in operation, the sixteen fans will move a total of 496,000 cubic feet of air per minute. This exhaust system assures the complete removal of spray vapors from all parts of the booth, even on the largest painting jobs.

The design and construction of this giant spray booth by DeVilbiss marks a long forward step in speeding the bomber output and in achieving the goal of mass war plane production.

New Airduster and Cleaner

A new type airduster to speed cleaning and dusting of tools, machines, parts, instruments, and pieces to be painted, is announced by the Paasche Airbrush Company, 1909 Diversey Parkway, Chicago, Ill. The tool is recommended for such jobs as cleaning dust from surfaces to be painted, blowing filings, chips and shavings from machined metal parts, cleaning tools, machines, jigs, motor armatures, etc. The gun operates on air pressure, consuming from 5 to 15 c.f.m. depending upon nozzle used. Many places ordinarily inaccessible can be reached easily and cleaned with this gun. 3″ and 6″ extensions, which may be coupled together, increase its utility. The airgun is ruggedly constructed of brass for hard use. Handle and trigger afford a natural easy grip. Hanger hook is provided so that gun may be kept handy for instant use.

Airduster and cleaner.

A new Bulletin F6-42 describing this airduster and also a new type Paasche hose cleaner, is available upon request.

Finishes for Plywood

A new development in finish for the fast expanding plywood plane and glider production that will release large quantities of critical metals is announced by Zapon Division, Atlas Powder Co., Stamford, Conn. This development is used in the manufacture of planes and gliders for the Army.

Features of the new war finish include impregnation of the wood and sealing to provide highest moisture resistance. It is specially designed to add a minimum of excess weight to planes and fits the high speed schedules consistent with rapid production of these craft. In addition to meeting a specific war need today, wide use of this finish is seen later, for peacetime purposes.

Manufacturers' Literature

Hose Cleaner

The Paasche Airbrush Company, 1909 Diversey Parkway, Chicago, Illinois, have recently published literature describing their type F1003 hose cleaner. This cleaner consists of a cylinder which is filled with solvent. The hose to be cleaned is connected to an outlet at the bottom and an air-line is connected at the top. Solvent is forced through the hose under pressure. Operating details and specifications are given in the literature.

Terpene Solvents

A new 21-page booklet discussing properties and applications of a series of terpene solvents has just been issued by the Naval Stores Department of Hercules Powder Company, Wilmington, Del.

The booklet emphasizes that while turpentine, which is composed of terpene hydrocarbons, has been used for many years as a solvent and thinner for protective coatings, it is but one of various terpene solvents available today. Thinners and solvents detailed in the booklet have been grouped under five classifications in accordance with their major constituents, as dicyclic terpene hydrocarbons; monocyclic terpene hydrocarbons; terpene alcohols; terpene ethers; and terpene ketones.

Included in the booklet are technical graphs on A.S.T.M. boiling ranges and distillation ranges and on the evaporation rates at 100° C. of Hercules terpene solvents. Structural formulas are pictured, together with tables of typical analyses, citing specific gravity, refractive index, unpolymerized residue, flash point, Kauri-butanol solvency value, aniline point, Ubbelohde viscosity and color.

In addition to the use of terpene solvents as single components of paint and varnish formulas, the company says, it is possible by proper selection among them to produce a wide variety of solvents which can be extended further or utilized for special purposes. Blending of terpene solvents by research chemists at the company's Experiment Station has yielded certain preliminary data on typical blends included in the booklet.

Solvency, volatility, flash point, odor, stability, drying time, flow, sagging, lifting, and skinning are discussed generally. None of the solvent blends tested was found to cause discoloration of white alkyd enamels when air-dried or baked, the booklet reports.

Patents

Varnish

U. S. Pat. 2,283,353 I. C. Clare, assignor to Hercules Powder Co., May 19, 1942. A varnish composition comprising as an ingredient the product of the reaction of a liquid derivative of a rosin, said derivative having a conjugated system of double bonds in the rosin nucleus, an unmodified oil-soluble phenol-aldehyde resin and a drying oil at a maximum temperature within the range of about 320° F. to about 600° F.

Wrinkle Finish

U. S. Pat. 2,283,420 F. E. Drummond & W. A. Waldie, assignor to New Wrinkle, Inc., May 19, 1942. A two stage method of drying films to a wrinkle finish comprising subjection for 5 to 15 minutes to infra-red radiation of between 7,200 and 14,000 Angstrom units to initiate wrinkling, and in the second stage to infra-red radiation of over 14,000 Angstrom units in a current of air to set the film to a hard wrinkle finish.

Paint Spray Nozzle

U. S. Pat. 2,283,762 W. C. Robinson, May 19, 1942. A paint spray nozzle of novel design having sliding paint and air tubes.

Organic Coating

U. S. Pat. 2,291,844 R. C. Swain & P. Adams, assignors to American Cyanamid Co., Aug. 4, 1942. A coating composition containing Pale East India resin and a substantial proportion of a melamine-formaldehyde resin which has at least 6 carbon atoms, wherein the molal ratio of formaldehyde to melamine is at least about 4:1 and wherein the weight ratio of melamine-formaldehyde resin to East India resin is up to about 3:2.

Founded as METAL INDUSTRY, January, 1903 by
PALMER H. LANGDON
1868-1935

METAL FINISHING

VOLUME 40 OCTOBER 1942 NUMBER 10

Publication Office:
116 John Street, New York

L. H. LANGDON
Publisher

THOMAS A. TRUMBOUR
Business Manager

DR. WALTER R. MEYER
Editor

PALMER H. LANGDON
Assistant Editor
Corps of Engineers, U. S. Army

JOAN TRUMBOUR
Advertising Manager

PUBLISHED MONTHLY—Copyright 1942 by The Metal Industry Publishing Company, Incorporated, 11 West 42nd St., New York, N. Y. Entered February 25, 1903, at New York, N. Y., as second class matter under Act of Congress, March 3, 1879. Re-entered as second class matter June 13, 1940, at the post office at New York, N. Y., under the Act of March 3, 1879.

SUBSCRIPTION PRICES: United States, $2.00 per year; Canada, $2.50 per year (includes 50c exchange and tax). Foreign $3.00. Single copies 25c. Please remit by check or money order; cash should be registered.

ADVERTISING RATES on application. Forms close the first of the month. Advertising copy should be mailed in time to reach us on or before the 20th of the preceding month.

METAL FINISHING reserves the right to investigate all products offered for advertisement, to refuse advertising considered unsuitable and to edit advertising copy when necessary.

CONTENTS

Editorial 517

Metal Congress at Cleveland 519

Applications of Bipolarity in Plating—By Frank K. Savage 524

Chromic Acid Anodizing Baths—By Winslow H. Hartford 527

Silver Plating Steel Over a Phosphate Coating—By Philip LoPresti 533

Hard Chromium Plating—By Austin Fletcher 536

A Modern Infra-Red Baking System—By Charles F. Miller 561

Ordnance Department Paint Developments—By E. T. McBride 563

Fire Protection for the Finishing Room—By P. W. Eberhardt 566

DEPARTMENTS

Patents 532

This is Washington 537

Shop Problems 541

New Equipment and Supplies 543

Manufacturers' Literature 544

New Books 548

Associations and Societies 551

Business Items 553

Supply Prices 38

Post Scripts 44

PALLITE PALLADIUM
PLATING SERVICE

We are now in a position to plate palladium from "Pallite" bath coating on steel, silver, brass or any other metal can be electroplated to give you a brilliant white non-tarnishing finish. Small as well as large parts are easily handled.

Palladium as plated from "Pallite" solution is a practical substitute for nickel and chromium.

This is not immersion deposit, therefore it has good adherence.

SPECTRONOME ELECTROPLATING COMPANY
8 East 12th Street
New York, N. Y.

METAL FINISHING HAS MOVED . . .

TO

11 West 42 Street, New York

In the metal finishing field ONLY Metal Finishing offers—Paid Circulation—ABC Circulation Audits—ABP editorial and business standards—Full Size 7 x 10-page visibility—comprehensive, wasteless, thoroughly up-to-the-minute list of interested buyers.

At this new address Metal Finishing's personnel will be more accessible, more readily available for service; closer to publishing and advertising centers in New York; closer to transportation facilities, hotels and clubs likely to be used by visitors.

Our out-of-town friends are cordially invited to visit us. Our offices are located on the twentieth floor.

Our New Telephone Numbers: PEnnsylvania 6-0226-7

METAL FINISHING

11 WEST 42 ST., NEW YORK

VOL. 40, NO. 10 METAL FINISHING OCTOBER, 1942
PREPARATION, ELECTROPLATING, COATING

Current Distribution in Chromium Plating

THE application of heavy chromium deposits to tools, dies and other objects to undergo wear, has focussed our attention on methods of obtaining more uniform distribution of plate and the most important factor is current distribution.

The first paper on this subject published by Dr. Charles Kasper of the United States Bureau of Standards, has served as a beacon light in the understanding of current distribution for linear, cylindrical and spherical conductors. This paper was presented at the Twenty-Sixth Annual Convention of the American Electroplaters' Society held in June, 1938 in Milwaukee, Wisconsin.

In this paper, it was shown that changing the distance between the anode and cathode had almost no effect unless the anode was relatively near the cathode. A consideration of equipotential surfaces shows that great variations in current density result when the cathode is placed at an angle to the anode. Inasmuch as, in many cases, heavy chromium plating is done on either the interior or exterior surfaces of cylindrical objects, the important conclusions based on Dr. Kasper's study for cylindrical objects, should be emphasized.

The most important conclusion is that relating to the extreme difficulty of obtaining a uniform current distribution over the interior of a circular cylinder employing a "concentric" circular cylindrical anode. In the practical parlance these results can be seen readily. In the distance corresponding to the difference between the two radii of the cylinders, the current distribution goes all the way from uniformity to a short circuit; that is, the ratio of the maximum current density to the minimum varies from 1:1 to ∞:0 (infinity to zero). Hence, if the internal electrode is comparable to the external in dimensions in this case, it may require extreme consideration of centering and trueness of the anode to obtain uniformity of current distribution.

Thus, for example, in the case of a cylindrical die of 5-inch radius, there would be a ratio of 6:1 for the maximum and minimum current densities on the cathode if the eccentricity is ¼-inch with an anode of 3-inch radius. On the other hand, if an anode with a radius of only 1-inch is used, an eccentricity of ¼-inch will only bring about a ratio of maximum to minimum current density on the cathode of the order of 3:1. In simple terms, this means that in all cases the wire used as anode should be as small as possible, taking into consideration, of course, the necessary current carrying capacity of the wire, and provided that the resistance of the arrangement, which can be readily computed from the ratio of the radii, will permit, for the available voltages, the necessary current to be drawn.

A curious fact, which is true with all two-dimensional systems such as this one (when the electrodes are at constant potential) is that the relationships are independent of absolute size, even for resistance. Thus, in this case, the resistance per unit length (say in inches) is merely dependent upon the logarithm of the ratio of the radii whether they be thousandths of an inch, inches, feet or miles. This is the characteristic of the logarithmic form the potential functions have. In the three-dimensional case, like the concentric spheres, the absolute size comes in and can be readily demonstrated through the insensitivity of current drawn by small objects, after they are a short distance from the anode.

Fatigue Vs. Efficiency

THE effects of fatigue on work efficiency have been studied extensively during the last few years, and in view of our efforts to obtain maximum war production, the findings of these studies should be utilized.

Even in routine work, a high degree of alertness is necessary and when fatigue sets in, reactions are slower, attention is easily diverted and accidents are more apt to happen.

Long hours of work, noise, poor illumination, poor ventilation, cramped working space, complexity of work, continuous concentration, poor posture, unsuitable clothing, ill health and irregular habits contribute to high fatigue.

Production records indicate the effects of physical and mental fatigue. Studies show that efficiency declines toward the latter part of the forenoon; after lunch it improves and then declines again more rapidly near the end of the work day.

Industrial efficiency can be improved by rest periods, food, better working techniques and habits. Rest periods of 10 to 15 minutes' duration in the middle of the morning and in the

PALLITE PALLADIUM
PLATING SERVICE

We are now in a position to plate palladium from "Pallite" bath coating on steel, silver, brass or any other metal can be electroplated to give you a brilliant white non-tarnishing finish. Small as well as large parts are easily handled.

Palladium as plated from "Pallite" solution is a practical substitute for nickel and chromium.

This is not immersion deposit, therefore it has good adherence.

SPECTRONOME ELECTROPLATING COMPANY
8 East 12th Street
New York, N. Y.

METAL FINISHING HAS MOVED . . .

TO

11 West 42 Street, New York

In the metal finishing field ONLY Metal Finishing offers—Paid Circulation—ABC Circulation Audits—ABP editorial and business standards—Full Size 7x10-page visibility—comprehensive, wasteless, thoroughly up-to-the-minute list of interested buyers.

At this new address Metal Finishing's personnel will be more accessible, more readily available for service; closer to publishing and advertising centers in New York; closer to transportation facilities, hotels and clubs likely to be used by visitors.

Our out-of-town friends are cordially invited to visit us. Our offices are located on the twentieth floor.

Our New Telephone Numbers: PEnnsylvania 6-0226-7

METAL FINISHING

11 WEST 42 ST., NEW YORK

VOL. 40, NO. 10 METAL FINISHING OCTOBER, 1942
PREPARATION, ELECTROPLATING, COATING

Current Distribution in Chromium Plating

THE application of heavy chromium deposits to tools, dies and other objects to undergo wear, has focussed our attention on methods of obtaining more uniform distribution of plate and the most important factor is current distribution.

The first paper on this subject published by Dr. Charles Kasper of the United States Bureau of Standards, has served as a beacon light in the understanding of current distribution for linear, cylindrical and spherical conductors. This paper was presented at the Twenty-Sixth Annual Convention of the American Electroplaters' Society held in June, 1938 in Milwaukee, Wisconsin.

In this paper, it was shown that changing the distance between the anode and cathode had almost no effect unless the anode was relatively near the cathode. A consideration of equipotential surfaces shows that great variations in current density result when the cathode is placed at an angle to the anode. Inasmuch as, in many cases, heavy chromium plating is done on either the interior or exterior surfaces of cylindrical objects, the important conclusions based on Dr. Kasper's study for cylindrical objects, should be emphasized.

The most important conclusion is that relating to the extreme difficulty of obtaining a uniform current distribution over the interior of a circular cylinder employing a "concentric" circular cylindrical anode. In the practical parlance these results can be seen readily. In the distance corresponding to the difference between the two radii of the cylinders, the current distribution goes all the way from uniformity to a short circuit; that is, the ratio of the maximum current density to the minimum varies from 1:1 to ∞:0 (infinity to zero). Hence, if the internal electrode is comparable to the external in dimensions in this case, it may require extreme consideration of centering and trueness of the anode to obtain uniformity of current distribution.

Thus, for example, in the case of a cylindrical die of 5-inch radius, there would be a ratio of 6:1 for the maximum and minimum current densities on the cathode if the eccentricity is ¼-inch with an anode of 3-inch radius. On the other hand, if an anode with a radius of only 1-inch is used, an eccentricity of ¼-inch will only bring about a ratio of maximum to minimum current density on the cathode of the order of 3:1. In simple terms, this means that in all cases the wire used as anode should be as small as possible, taking into consideration, of course, the necessary current carrying capacity of the wire, and provided that the resistance of the arrangement, which can be readily computed from the ratio of the radii, will permit, for the available voltages, the necessary current to be drawn.

A curious fact, which is true with all two-dimensional systems such as this one (when the electrodes are at constant potential) is that the relationships are independent of absolute size, even for resistance. Thus, in this case, the resistance per unit length (say in inches) is merely dependent upon the logarithm of the ratio of the radii whether they be thousandths of an inch, inches, feet or miles. This is the characteristic of the logarithmic form the potential functions have. In the three-dimensional case, like the concentric spheres, the absolute size comes in and can be readily demonstrated through the insensitivity of current drawn by small objects, after they are a short distance from the anode.

Fatigue Vs. Efficiency

THE effects of fatigue on work efficiency have been studied extensively during the last few years, and in view of our efforts to obtain maximum war production, the findings of these studies should be utilized.

Even in routine work, a high degree of alertness is necessary and when fatigue sets in, reactions are slower, attention is easily diverted and accidents are more apt to happen.

Long hours of work, noise, poor illumination, poor ventilation, cramped working space, complexity of work, continuous concentration, poor posture, unsuitable clothing, ill health and irregular habits contribute to high fatigue.

Production records indicate the effects of physical and mental fatigue. Studies show that efficiency declines toward the latter part of the forenoon; after lunch it improves and then declines again more rapidly near the end of the work day.

Industrial efficiency can be improved by rest periods, food, better working techniques and habits. Rest periods of 10 to 15 minutes' duration in the middle of the morning and in the

PALLITE PALLADIUM
PLATING SERVICE

We are now in a position to plate palladium from "Pallite" bath coating on steel, silver, brass or any other metal can be electroplated to give you a brilliant white non-tarnishing finish. Small as well as large parts are easily handled.

Palladium as plated from "Pallite" solution is a practical substitute for nickel and chromium.

This is not immersion deposit, therefore it has good adherence.

SPECTRONOME ELECTROPLATING COMPANY
8 East 12th Street
New York, N. Y.

METAL FINISHING HAS MOVED . . .

TO

11 West 42 Street, NEW YORK

In the metal finishing field ONLY Metal Finishing offers—Paid Circulation—ABC Circulation Audits—ABP editorial and business standards —Full Size 7 x 10-page visibility—comprehensive, wasteless, thoroughly up-to-the-minute list of interested buyers.

At this new address Metal Finishing's personnel will be more accessible, more readily available for service; closer to publishing and advertising centers in New York; closer to transportation facilities, hotels and clubs likely to be used by visitors.

Our out-of-town friends are cordially invited to visit us. Our offices are located on the twentieth floor.

Our New Telephone Numbers: PEnnsylvania 6-0226-7

METAL FINISHING

11 WEST 42 ST., NEW YORK

VOL. 40, NO. 10 METAL FINISHING OCTOBER, 1942
PREPARATION, ELECTROPLATING, COATING

Current Distribution in Chromium Plating

THE application of heavy chromium deposits to tools, dies and other objects to undergo wear, has focussed our attention on methods of obtaining more uniform distribution of plate and the most important factor is current distribution.

The first paper on this subject published by Dr. Charles Kasper of the United States Bureau of Standards, has served as a beacon light in the understanding of current distribution for linear, cylindrical and spherical conductors. This paper was presented at the Twenty-Sixth Annual Convention of the American Electroplaters' Society held in June, 1938 in Milwaukee, Wisconsin.

In this paper, it was shown that changing the distance between the anode and cathode had almost no effect unless the anode was relatively near the cathode. A consideration of equipotential surfaces shows that great variations in current density result when the cathode is placed at an angle to the anode. Inasmuch as, in many cases, heavy chromium plating is done on either the interior or exterior surfaces of cylindrical objects, the important conclusions based on Dr. Kasper's study for cylindrical objects, should be emphasized.

The most important conclusion is that relating to the extreme difficulty of obtaining a uniform current distribution over the interior of a circular cylinder employing a "concentric" circular cylindrical anode. In the practical parlance these results can be seen readily. In the distance corresponding to the difference between the two radii of the cylinders, the current distribution goes all the way from uniformity to a short circuit; that is, the ratio of the maximum current density to the minimum varies from 1:1 to ∞:0 (infinity to zero). Hence, if the internal electrode is comparable to the external in dimensions in this case, it may require extreme consideration of centering and trueness of the anode to obtain uniformity of current distribution.

Thus, for example, in the case of a cylindrical die of 5-inch radius, there would be a ratio of 6:1 for the maximum and minimum current densities on the cathode if the eccentricity is ¼-inch with an anode of 3-inch radius. On the other hand, if an anode with a radius of only 1-inch is used, an eccentricity of ¼-inch will only bring about a ratio of maximum to minimum current density on the cathode of the order of 3:1. In simple terms, this means that in all cases the wire used as anode should be as small as possible, taking into consideration, of course, the necessary current carrying capacity of the wire, and provided that the resistance of the arrangement, which can be readily computed from the ratio of the radii, will permit, for the available voltages, the necessary current to be drawn.

A curious fact, which is true with all two-dimensional systems such as this one (when the electrodes are at constant potential) is that the relationships are independent of absolute size, even for resistance. Thus, in this case, the resistance per unit length (say in inches) is merely dependent upon the logarithm of the ratio of the radii whether they be thousandths of an inch, inches, feet or miles. This is the characteristic of the logarithmic form the potential functions have. In the three-dimensional case, like the concentric spheres, the absolute size comes in and can be readily demonstrated through the insensitivity of current drawn by small objects, after they are a short distance from the anode.

Fatigue Vs. Efficiency

THE effects of fatigue on work efficiency have been studied extensively during the last few years, and in view of our efforts to obtain maximum war production, the findings of these studies should be utilized.

Even in routine work, a high degree of alertness is necessary and when fatigue sets in, reactions are slower, attention is easily diverted and accidents are more apt to happen.

Long hours of work, noise, poor illumination, poor ventilation, cramped working space, complexity of work, continuous concentration, poor posture, unsuitable clothing, ill health and irregular habits contribute to high fatigue.

Production records indicate the effects of physical and mental fatigue. Studies show that efficiency declines toward the latter part of the forenoon; after lunch it improves and then declines again more rapidly near the end of the work day.

Industrial efficiency can be improved by rest periods, food, better working techniques and habits. Rest periods of 10 to 15 minutes' duration in the middle of the morning and in the

middle of the afternoon have proved to be valuable aids in reducing fatigue and increasing production. These serve for relaxation and also can be used for eating a small amount of food. The relaxation is particularly important when the work is of a monotonous nature, such as racking of work for plating.

Illumination is particularly important and changes in illumination by new lighting and the use of reflective paints have increased production in actual cases by from 15 to 20 per cent as well as having reduced the number of accidents. Eyestrain is particularly contributory to fatigue and in addition to proper illumination, periodic eye check-ups should be made. Many employees do not attend to their eyes until astigmatism or myopia have made seeing very difficult — all the time working under greater strain with lowered efficiency.

Ventilation is an important factor in plating. Hidden reductions in efficiency may result by continuous breathing small amounts of solvent fumes, cyanide fumes or nitric oxide fumes, because of lowered red cell counts, headaches and sinusitis, which may not be severe enough to incapacitate the workman.

With the increasing shortage of labor, all factors capable of increasing production should and must be considered and fatigue ranks high in importance.

Corrosion Resistance of Bright-Dipped Cadmium

IN THE bright dipping of cadmium using the chromic acid-sulfuric acid bright dip, approximately 0.00001" of coating is removed during the normal dipping time and it was not certain whether the removal of this amount of coating reduced the corrosion protection of the cadmium.

In an article recently published by the Electrochemical Society, work was done indicating that the normal use of the chromic acid bright dip did not result in a decrease in the corrosion protection afforded by cadmium, providing the thickness was more than 0.0001". The reason for this is probably the formation of a passive film on the cadmium after bright dipping in the chromic acid solution, and an actual improvement in corrosion resistance was observed for coatings of the order of thickness of 0.0003".

There are no published data available indicating whether similar effects are experienced by the use of other types of bright dips for cadmium.

Imported Cresylic Acid

CRESYLIC acid, which is a commercial term for a mixture of ortho, meta and para cresols, is an important product in the manufacture of organic finishes, plastics, disinfectants and cleaners.

A large volume of the cresylic acid used in the United States was imported from England, and prior to a fixing of a price ceiling, the cost of imported cresylic acid was approximately one dollar per gallon higher than American-produced cresylic acid. It was felt by many that this price was exorbitantly high.

On August 5th, the OPA established a ceiling price for imported cresylic acid of $1.10 per gallon. This price was based on an ex-British works cost of seventy cents per U. S. gallon. Under the established price ceiling, there was not the incentive to sell importers in this country and English agents turned to South American buyers for more attractive prices. As a result, the importation of cresylic acid from Great Britain has decreased greatly during the past few weeks.

Due to the great need for cresylic acid in this country, efforts should be made to direct its flow to the United States, especially in view of the large lend-lease shipments of phenol being made to the Allied Nations. The matter could be corrected by either an adjustment in the price ceiling on imported cresylic acid or by statesmanship.

Germany To Get Turkish Chromium

A disturbing report was noted recently from Ankara, Turkey, relative to the fact that Turkey has contracted with the German Krupp Armament Company to exchange 45,000 tons of chromium ore for war materials.

The British monopoly on Turkish chromium expires on January 8th, 1943 and the exchange agreement with Germany is scheduled to go into effect one week later.

The German government is to furnish over $14,000,000 worth of assorted arms, excluding tanks and planes, in exchange for the 45,000 tons of chromium ore.

If the new exchange goes into effect, Great Britain will have to draw on the same sources of chromium as those used by the United States, namely New Caledonia, Cuba and Africa. Unfortunately, large ore bodies were lost when the Japanese took over the Philippines.

Increased production of chromium and chromic acid from low grade ores in the United States should be able to take care of the situation if the supply becomes short in the United States.

From a military standpoint, the Turkish action is particularly unfortunate inasmuch as Germany has only a very limited source of chromium. It is possible that difficulties in delivery because of the severely taxed transportation system in the Balkans may prevent at least complete fulfillment of the exchange agreement.

"METAL FINISHING" AT NEW ADDRESS

The offices of Metal Industry Publishing Company were moved on October 7th from 116 John Street to 11 West 42nd Street, New York City. This new location is within five minutes' walk of Grand Central Station and the offices, therefore, are much more readily accessible for out-of-town travelers.

Metal Congress at Cleveland

Engineering, Technical and Production Talents to Be Mobilized in Drive for Greater Production

PLANS for the greatest mobilization of engineering, technical and production talent in the metal industry have been completed for the National Metal Congress and War Production Edition of the National Metal Exposition, to be held in Cleveland's Public Auditorium, October 12 through 16.

"This year's meeting will be far different from any held in the 24-year history of this big event," according to *W. H. Eisenman*, Secretary of the American Society for Metals, and managing director of the Exposition.

"The keynote this year will be education—education that will be devoted solely to increasing production of war products. All the technical talent of the four cooperating societies, all of the engineering and production experts of more than 250 leading manufacturers, are being mobilized in this drive to help the metal industry do more with what it already has, to marshall every idea, every impoved production method that will help win this war of metals."

Mr. Eisenman likened the meeting to a great university with some 200,000 square feet devoted to class rooms, lecture halls, conference and display spaces, with a faculty of thousands of technical and production wizards, the "know hows" and the "know whys" of the industry, men who are anxious and willing to discuss, counsel and advise as to how we can do more with what we have.

War Production Sessions

Among the many drawing cards to the meeting will be twenty-five ASM War Production Sessions patterned after the successful defense meetings at last year's Congress. Outstanding authorities in government and industry will speak briefly, informally and off-the-record on important phases of these twenty-five timely topics, with all speakers acting later as members of an Information Panel for open discussion.

These ASM War Production Sessions will be definitely practical, operating on a give-and-take basis with metal men getting answers to their problems and contributing to the solution of others.

These sessions will be entirely in addition to the technical sessions of the four cooperating societies. They will be held every afternoon and the first three evenings of the week at meeting rooms in Cleveland Public Auditorium.

Metal Exposition

The Auditorium will also be the scene of the War Production Edition of the National Metal Exposition, with more than 250 leading manufacturers contributing to the meeting's theme—an educational drive to help increase production of war products.

These companies will have their leading technical and engineering experts manning educational and conference displays which will be located on the arena floor, the lower exhibit hall, and in the north exhibit hall and arcade of the Auditorium. In addition to the educational exhibits of more than 250 companies, many government agencies will be represented in conference displays.

The Exposition will be open daily from 12:00 noon until 10:30 P.M. with the exception of Thursday when it will close at 6:00 P.M. Admission will be free to all members of technical societies and to those holding executive passes distributed by exhibiting firms. Members of any technical society can register upon presentation of their membership cards. Such registration provides admission to the Congress and Exposition for the entire week.

Technical Sessions

Some 100 papers will be presented at the regular sessions of the four cooperating societies — the American Society for Metals, the Wire Association, the American Welding Society and Iron and Steel and Metals Divisions of the American Institute of Mining & Metallurgical Engineers.

One of the features of the ASM Program will be a series of five daily lectures on tool steels by *James P. Gill*, Chief Metallurgist, Vanadium-Alloys Steel Company.

All morning sessions of the ASM will be held at the Statler Hotel, headquarters during the week for this Society, while afternoon and evening sessions will be at Public Auditorium.

All morning sessions will be adjourned promptly at 11:30 to permit attendance at the meetings in the Statler Ballroom to be addressed by high government and War Production Board officials.

Other ASM events of outstanding importance will be the annual meeting and the Campbell Memorial Lecture on Wednesday morning, October 14, and the annual ASM dinner Thursday evening, both to be held in the Statler Ballroom. *John Chipman*, Prof. of Metallurgy at Mass. Institute of Technology, will deliver this year's Campbell Memorial Lecture.

A symposium on rare metals will feature the A.I.M.E.'s Metals division program, while production will be the theme of the Iron and Steel Division. Hotel headquarters will be at the Statler. The American Welding Society's headquarters will be at Hotel Cleveland, with the Wire Association at the Carter Hotel.

Awards

Several important awards will be made at the ASM dinner Thursday evening, with *Benjamin F. Shepherd* of Ingersoll-Rand Co., and Past President of ASM, receiving the Albert Sauveur Achievement Award, and *John C. Garand*, inventor of the Garand Automatic Rifle, and member of the ASM, Springfield Chapter, receiving a special award. *Dr. Oscar E. Harder* will receive the President's Medal, and the Henry Marion Howe

Medal will be awarded during the evening.

CONVENTION PROGRAM

American Society for Metals

Headquarters—Hotel Statler

Monday Morning, October 12

9:30 A.M. "Effect of Elements in Solid Solution on Hardness and Response to Heat Treatment of Iron Binary Alloys", by *C. R. Austin*, Pennsylvania State College.

10:10 A.M. "Third Element Effects on Hardenability of a Pure Hyper-Eutectoid Iron-Carbon Alloy", by *C. R. Austin*, Pennsylvania State College, *W. G. Van Note*, North Carolina State College, and *T. A. Prater*, Pennsylvania State College.

10:50 A.M. "The 'Ar' Range in Some Iron-Cobalt-Tungsten Alloys", by *W. P. Sykes*, General Electric Co.

Simultaneous Session

9:30 A.M. "The Effect of Hardness on the Machinability of Six Alloy Steels", by *O. W. Boston* and *L. V. Colwell*, University of Michigan.

10:10 A.M. "Carburizing Characteristic of 0.20 Per Cent Carbon Alloy and Plain Carbon Steels", by *G. K. Manning*, Republic Steel Corp.

10:50 A.M. "The Metallography of Galvanized Sheet Steel Using a Specially Prepared Polishing Medium With Controlled pH", by *D. H. Rowland* and *O. E. Romig*, Carnegie-Illinois Steel Corp.

Simultaneous Session

9:30 A.M. "Bursting Tests on Notched Alloy Steel Tubing", by *G. Sachs* and *J. D. Lubahn*, Case School of Applied Science.

10:00 A.M. "Notched Bar Tensile Tests on Heat Treated Low Alloy Steels", by *G. Sachs* and *J. D. Lubahn*, Case School of Applied Science.

10:30 A.M. "Stress-Strain Measurements in the Drawing of Cylindrical Cups", by *E. L. Bartholomew, Jr.*, Massachusetts Institute of Technology.

11:00 A.M. "Fatigue Strength of Normalized and Tempered Versus as-Forged Full-Size Railroad Car Axles", by *O. J. Horger* and *T. V. Buckwalter*, Timken Roller Bearing Co.

Tuesday Morning, October 13

9:30 A.M. "The End-Quench Test: Reproducibility", by *Morse Hill*, Wright Field.

10:10 A.M. "The End-Quench Test: Hardenability of Aircraft Steels and Its Representation", by *Morse Hill*, Wright Field.

10:50 A.M. "Hardenability Control of A One Per Cent Carbon Steel", by *G. R. Barrow* and *Gilbert Soler*, Timken Roller Bearing Co.

Simultaneous Session

9:30 A.M. "The Alpha Iron Lattice Parameter as Affected by Molybdenum, and an Introduction to the Problem of the Partition of Molybdenum in Steel", by *F. E. Bowman*, *R. M. Parke* and *A. J. Herzig*, Climax Molybdenum Co.

10:10 A.M. "The Effect of Molybdenum on the Isothermal, Subcritical Transformation of Austenite in Eutectoid and Hyper-Eutectoid Steels", by *J. R. Blanchard*, *R. M. Parke* and *A. J. Herzig*, Climax Molybdenum Co.

10:50 A.M. "The Effect of Molybdenum on the Rate of Diffusion of Carbon in Austenite", by *J. L. Ham*, *R. M. Parke* and *A. J. Herzig*, Climax Molybdenum Co.

Simultaneous Session

9:30 A.M. "The Method of Thin Films for the Study of Intermetallic Diffusion and Chemical Reactions at Metallic Surfaces", by *H. S. Coleman* and *H. L. Yeagley*, Pennsylvania State College.

10:10 A.M. "On the Location of Flaws by Stereo-Radiography", by *James Rigbey*, Ford Motor Company of Canada.

10:50 A.M. "The Fluorescent Penetrant Method of Detecting Discontinuities", by *Taber de Forest*, Magnaflux Corp.

Wednesday Morning, October 14
9:00 A.M.

ANNUAL MEETING OF THE AMERICAN SOCIETY FOR METALS

1942 EDWARD DE MILLE CAMPBELL MEMORIAL LECTURE, by *John Chipman*, Massachusetts Institute of Technology.

Thursday Morning, October 15

9:30 A.M. "A Metallographic Study of the Formation of Austenite from Aggregates of Ferrite and Cementite in an Iron-Carbon Alloy of 0.5 Per Cent Carbon", by *T. G. Digges* and *S. J. Rosenberg*, National Bureau of Standards.

10:10 A.M. "Influence of Initial Structure and Rate of Heating on the Austenitic Grain Size of 0.5 Per Cent Carbon Steels and Iron-Carbon Alloy", by *T. G. Digges* and *S. J. Rosenberg*, National Bureau of Standards.

10:50 A.M. "The Mechanism and the Rate of Formation of Austenite from Ferrite-Cementite Aggregates", by *G. A. Roberts*, Vanadium-Alloys Steel Co., and *R. F. Mehl*, Carnegie Institute of Technology.

Simultaneous Session

9:30 A.M. "The Tantalum-Carbon System", by *F. H. Ellinger*, General Electric Co.

10:10 A.M. "Influence of Strain Rate on Strength and Type of Failure of Carbon-Molybdenum Steel at 850, 1000 and 1100 Degrees Fahr.", by *R. F. Miller* and *G. V. Smith*, U. S. Steel Corp., and *G. L. Kehl*, Columbia University.

10:50 A.M. "Rupture Tests at 200 Degrees Cent. on Some Copper Alloys", by *E. R. Parker* and *C. Ferguson*, General Electric Co.

Simultaneous Session

9:30 A.M. "Corrosion of Water Pipes in a Steel Mill, by *C. L. Clark*, Timken Roller-Bearing Co., and *W. J. Nungester*, University of Michigan.

10:10 A.M. "A Study of the Iron-Rich Iron-Manganese Alloys", by *A. R. Troiano* and *F. T. McGuire*, University of Notre Dame.

10:50 A.M. "The Induction Furnace as a High Temperature Calorimeter and the Heat of Solution of Silicon in Liquid Iron", by *John Chipman* and *N. J. Grant*, Massachusetts Institute of Technology.

7:00 P.M.

A.S.M. Dinner—Statler Hotel Ballroom

Friday Morning, October 16

9:30 A.M. "The Hardening of Tool Steels", by *Peter Payson* and *J. L. Klein*, Crucible Steel Company of America.

10:10 A.M. "The Kinetics of Austenite Decomposition in High Speed Steel", by *Paul Gordon* and *Morris Cohen*, Massachusetts Institute of Technology, and *R. S. Rose*, Vanadium-Alloys Steel Co.

10:50 A.M. "The Tempering of Two High-Carbon High-Chromium Steels", by *Otto Zmeskal*, Illinois Institute of Technology, and *Morris Cohen*, Massachusetts Institute of Technology.

Simultaneous Session

9:30 A.M. "Some Aspects of Strain Hardenability of Austenitic Manganese Steel", by *D. Niconoff*, Republic Steel Corp.

10:10 A.M. "The Precipitation Reaction in Aged Cold-Rolled One Per Cent Cd-Cu: Its Effects on Hardness, Conductivity, and Tensile Properties", by *R. H. Harrington* and *L. E. Cole*, General Electric Co.

10:50 A.M. "The Effect of Moderate Cold Rolling on the Hardness of the Surface

Layer of 0.34 Per Cent Carbon Steel Plates," by *Harry K. Herschman*, National Bureau of Standards.

Simultaneous Session

9:30 A.M. "The Metallography of Commercial Magnesium Alloys", by *J. B. Hess* and *P. F. George*, The Dow Chemical Co.

10:10 A.M. "Study of Inverse Segregation Suggests New Method of Making Certain Alloys", by *M. L. Samuels, A. R. Elsea* and *K. Grube*, Battelle Memorial Institute.

10:50 A.M. "Effects of Various Solute Elements on the Hardness and Rolling Texture of Copper", by *R. M. Brick*, Yale University, *D. L. Martin*, General Electric Co., and *R. P. Angler*, Handy & Harman.

EDUCATIONAL COURSE
5:00 P.M. Daily

"TOOL STEELS", by *J. P. Gill*, Vanadium-Alloys Steel Co.

Twenty-Third Annual Meeting American Welding Society

Week of October 12, 1942

Hotel Cleveland, Cleveland, Ohio

Monday, October 12th, Morning—9:30 A.M.

OPENING SESSION

Chairman—G. F. JENKS
President, American Welding Society

Vice-Chairman—E. V. DAVID
Chairman, Convention Committee

PRESENTATION OF MEDALS AND PRIZES

TECHNICAL SESSION—10:15 A.M.

TRAINING OF WELDING OPERATORS AND QUALIFICATIONS

Chairman—K. L. HANSEN
Harnischfeger Corp.
Vice-Chairman—E. T. SCOTT
Cleveland School of Welding

"Training of Welding Foremen", by *F. H. Achard*, Supervisor of Training, Consolidated Edison Co. of New York, Inc.
"Instruction Methods in Welding Developed by U. S. Office of Education", by *H. K. Hogan*, U. S. Office of Education.

Opening Metals Exposition—12:00 Noon

Monday Afternoon—2:00 P.M.

FATIGUE AND IMPACT

Chairman—A. E. GIBSON
Wellman Engineering Co.
Vice-Chairman—F. L. PLUMMER
Hammond Iron Works

"Fatigue Strength of Metal Subjected to Combined Stresses", by *L. H. Donnell*, Illinois Institute of Technology.
"Fatigue Strength of Commercial Butt Welds in Carbon Steel Plates", by *W. M. Wilson*, University of Illinois.
"Fatigue Tests of Full Thickness Plates With and Without Butt Welds", by *E. C. Huge* and *H. J. Kerr*, The Babcock & Wilcox Co.
"Impact Strength of High Alloy Steel Welds", by *E. C. Chapman*, Combustion Eng. Co.

WAR PRODUCTION

Chairman—R. J. KRIZ
The James H. Herron Co.
Vice-Chairman—A. F. DAVIS
The Lincoln Electric Co.

"Some Special Applications of Flame Hardening", by *Stephen Smith*, Air Reduction Sales Co.
"High Quality Welding—Vertical and Overhead Positions With Alternating Current", by *H. O. Westendarp*, General Electric Co.
"Conservation and Effective Use of Equipment and Supplies for Welding and Cutting", by *H. ULLMER*, The Linde Air Products Co.
"Welding Gun Mounts", by *W. B. Lair*, York Safe and Lock Co.

Monday Evening—7:30 P.M.

MOTION PICTURE FILMS

"The Inside of Welding"—Educational film by General Electric Company.
"The Welding of Aluminum"—Aluminum Company of America.
"Fundamentals of Oxyacetylene Welding"—Courtesy Navy Department.

Tuesday, October 13th, Morning—9:30 A.M.

WELDABILITY OF STEEL

Chairman—A. B. KINZEL
Union Carbide and Carbon Res. Labs.
Vice-Chairman—A. G. BISSELL
Bureau of Ships, Navy Dept.

"Cooling Rates as Affecting Weldability", by *G. E. Doan* and *R. D. Stout*, Lehigh University.
"Effects of Cooling Rate on the Properties of Arc Welded Joints", by *W. F. Hess*, Rensselaer Polytechnic Institute.
"Weld Quench Gradient Tests", by *W. H. Bruckner*, University of Illinois.

AIRCRAFT WELDING (Fuselage)

Chairman—P. H. MERRIMAN
The Glenn L. Martin Co.
Vice-Chairman—J. F. MAINE
Republic Structural Iron Works

"Welding of Airplane Propeller Blades", by *C. A. Liedholm*, Curtiss-Wright Corp.
"Welding of New Types of Alloy Steels in Aircraft Structures", by *A. R. Lytle*, Union Carbide and Carbon Res. Labs.
"Effect of Current on the Welding of X4130 Aircraft Tubing", by *W. T. Tiffin*, University of Oklahoma.

Tuesday Afternoon—2:00 P.M.

WELDABILITY OF STEEL

Chairman—C. H. JENNINGS
Westinghouse Elec. and Mfg. Co.
Vice-Chairman—G. B. CARSON
Case School of Applied Science

"Bead Hardness and Bead Bend Tests on Carbon-Manganese Steels", by *O. E. Harder* and *C. B. Voldrich*, Battelle Memorial Institute.
"Weldability of Carbon-Manganese Steels", by *C. E. Jackson*, Naval Research Lab.
"Jominy and Quench Tests on Carbon-Manganese Steels", by *G. A. Timmons*, Climax Molybdenum Company.
"T-Bend Tests of Carbon-Manganese Steels", by *L. C. Bibber* and *J. Heuschkel*, Carnegie-Illinois Steel Corp.

AIRCRAFT WELDING (Sheet)

Chairman—G. O. HOGLUND
Aluminum Company of America
Vice-Chairman—JOHN D. GORDON
Taylor-Winfield Corp.

"Spot Welding in Aircraft Structures", by *E. S. Jenkins*, Curtiss-Wright Corp.
"Standards and Recommended Practices and Procedures for Spot Welding Aluminum Alloys", by *G. S. Mikhalapov*, Chairman, Aircraft Welding Standards Committee.
"Arc Welding of Magnesium Alloys", by *W. S. Loose* and *A. R. Orban*, The Dow Chemical Co.
"Welding in Aircraft", by *Francis H. Stevenson*, Vega Aircraft Corp.

GAS CUTTING

Chairman—J. R. DAWSON
Union Carbide and Carbon Res. Labs.
Vice-Chairman—C. A. LOOMIS
Bureau of Ships, Navy Dept.

"Gas Cutting in Steel Mills", by *S. D. Baumer*, Air Reduction Sales Company.
"Improved Methods of Machine Flame Cutting", by *H. E. Rockefeller*, The Linde Air Products Co.
"Factors Affecting the Accuracy of Machine Cutting", by *Howard Hughey* and *A. H. Yoch*, Air Reduction Sales Co.

Tuesday Evening—7:30 P.M.

FUNDAMENTAL RESEARCH CONFERENCE

H. C. BOARDMAN, *Chairman*, Presiding

Wednesday, October 14th, Morning—9:30 A.M.

RESISTANCE WELDING

Chairman—G. N. SIEGER
S-M-S Corporation
Vice-Chairman—B. L. WISE
Federal Machine & Welder Co.

"Refrigerant Cooled Spot Welding Electrodes", by *F. R. Hensel, E. I. Larsen* and *E. F. Holt*, P. R. Mallory & Co.
"Spot Welding of Hardenable Steels", by

W. F. Hess and *D. C. Herrschaft*, Rensselaer Polytechnic Institute.
"Unusual Resistance Welding Developments and Operations", by *R. T. Gillette*, General Electric Co.
"Resistance Welding Trench Mortar Fin Assembly", by *J. H. Cooper*, Taylor-Winfield Corp.

PRODUCTION WELDING

Chairman—O. B. J. FRASER
International Nickel Co.
Vice-Chairman—D. H. COREY
The Detroit Edison Co.

"Welding with Aluminum Bronze", by *Clinton E. Swift*, Ampco Metal, Inc.
"Adapting Automatic Electric Welding to Routine Production", by *J. M. Keir*, The Linde Air Products Co.
"Welded Steel Tubing and Its Application in War Production", by *H. S. Card*, Formed Steel Tube Institute.

Wednesday Afternoon—2:00 P.M.

RESISTANCE WELDING

Chairman—R. E. POWELL
Western Electric Co.
Vice-Chairman—J. D. TEBBEN
P. R. Mallory & Co.

"The Spot Welding of NAX High Tensile Steel", by *C. R. Schroder*, Great Lakes Steel Corp.
"Application of Copper Oxide Rectifiers for Resistance Welding", by *R. L. Briggs*, Thomson Gibb Electric Welding Co.
"The Effect of Weld Spacing on the Strength of Spot-Welded Joints", by *R. Della-Vedowa* and *M. M. Rockwell*, Lockheed Aircraft Corp.
"Preparation of Aluminum Alloys for Production Spot Welding", by *T. E. Piper*, Northrop Aircraft, Inc.

WELDING OF ORDNANCE

Chairman—H. L. R. WHITNEY
War Production Board
Vice-Chairman—H. C. BOARDMAN
Chicago Bridge & Iron Co.

"Conservation and Substitution of Critical Materials in Filler Metals", by *A. N. Kugler*, Air Reduction Sales Co.
"Manual and Automatic Welding of Heavy Plate of Hardenable Alloys", by *L. A. Danse*, Cadillac Motor Car Co.
"Developments in Cast Iron Welding Rods and Electrodes", by *R. J. Franklin*, Chicago Hardware Foundry Co.
"Electric Welding of Mobile Artillery Gun Carriages", by *G. E. Campbell*, Pettibone-Mulliken Corp.

SHIPBUILDING

Chairman—DAVID ARNOTT
American Bureau of Shipping
Vice-Chairman—A. L. PFEIL
Universal Power Corp.

"Suggested Methods Which Will Increase Welding Production and Decrease Welding Costs", by *J. F. Lincoln*, Lincoln Electric Co.
"Distortion and Shrinkage Problems in Ships & Other Large Structures", by *Lamotte Grover*, Air Reduction Co.
"Motor Boat Construction and Small Ships", by *W. E. Whitehouse*, Defoe Shipbuilding Co.
"Application of Welding in Submarine Construction", by *E. H. Ewertz*, Electric Boat Co. & *R. D. West*, Manitowoc Shipbuilding Co.

Wednesday Evening—7:30 P.M.

SECTION OFFICERS DINNER AND CONFERENCE

Thursday, October 15th, Morning—9:30 A.M.

AIRCRAFT WELDING

Chairman—S. L. HOYT
Battelle Memorial Institute
Vice-Chairman—E. VOM STEEG
General Electric Co.

"Utility Characteristics of Aircraft Electrodes", by *C. B. Voldrich* and *R. D. Williams*, Battelle Memorial Institute.
"Results of Survey on Current Arc Welding Practice in Aircraft Industry", by *Maurice Nelles*, Chairman, Western Aircraft Welding Committee.
"Copper Welding for Aircraft", by *T. V. Buckwalter*, Timken Roller Bearing Co.

NON-DESTRUCTIVE TESTS AND INSPECTION

Chairman—J. J. CROWE
Air Reduction Sales Co.
Vice-Chairman—O. R. CARPENTER
Babcock & Wilcox Co.

"Correlation of Metallographic and Radiographic Examinations of Spot Welds in Aluminum Alloys", by *Dana W. Smith* and *Fred Keller*, Aluminum Company of America.
"The Magnetic Powder Method for Inspecting Weldments and Castings for Sub-Surface Defects", by *Carleton Hastings*, Watertown Arsenal.
"Radiographic Inspection of Welded Armor Plates and Castings", by *Don M. McCutcheon*, Ford Motor Co.

Thursday Morning—9:30 A.M.

"Visual Inspection of Arc Welds", by *W. L. Warner*, Watertown Arsenal.

Thursday Afternoon—2:00 P.M.

BUSINESS MEETING

Thursday Afternoon—3:00 P.M.

BOARD OF DIRECTORS MEETING

Wire Association Convention —1942

Association Headquarters—Hotel Carter

Monday, October 12

10:00 A.M. Directors Meeting.
12:00 Noon Program Committee Luncheon.
2:00 P.M. President's Address of Welcome (Short).
2:15 P.M.

TECHNICAL SESSION

Chairman of the Meeting
H. H. TIMBERS, *Contract License Mgr.*
Western Electric Co., New York, N. Y.

"Salvage"—War Production Board Speaker.
Motion Picture—"Mines Above Ground"—Conservation of Scrap and Waste Material. Western Electric Company, New York, N. Y.
"Rubber Insulation Substitutes"—Paper by Bell Telephone Laboratories.

Tuesday, October 13

10:00 A.M.

TECHNICAL SESSION

Chairman of the Meeting
EARL H. THOMAS, *Superintendent*
George W. Prentiss Co., Holyoke, Mass.

"Wire Mill Safety Praetices", Paper by *R. H. Ferguson*, Mgr. of Safety, Republic Steel Corp., Cleveland, Ohio.
"Scheduling and Planning the Wire Mill for War Production", Paper by *L. D. Seymour*, Asst. Wks. Mgr., Canada Works, Steel Co. of Canada, Ltd., Hamilton, Ont., Canada.
1:00 P.M. Wire Association Annual Luncheon. Guest Speakers: *Hon. Everett M. Dirksen*, Congressman of the Sixteenth District of Illinois, and *Dr. Charles Copeland Smith*, National Association of Manufacturers, New York, N. Y.
4:30 P.M. Wire Association Annual Meeting.

Wednesday, October 14

10:00 A.M.

TECHNICAL SESSION

Chairman of the Meeting
W. H. CRAWFORD, Resident Manager,
Eaton Manufacturing Company
Massillon, Ohio

"Tungsten Carbide Applications", Paper by *A. MacKenzie*, Vice Pres. Chg. Mfg., Carboloy Company, Inc., Detroit, Mich.

MORDICA MEMORIAL LECTURE

"Steel and Wire", by *Louis H. Winkler*, Met. Engr., Bethlehem Steel Co., Bethlehem, Pa.
2:00 P.M.

TECHNICAL SESSION

Chairman of the Meeting
W. B. FARNSWORTH, Chief Met.
Pittsburgh Steel Company
Monessen, Pa.

"Trouble Shooting on Bronze and Steel Weaving Wire", Paper by *L. D. Granger*, Asst. to Vice President, Wickwire Spencer Steel Co., New York, N. Y.
"Welding Electrodes", Paper by *Dr. John W. Miller*, Metallurgist, Reid-Avery Company, Dundalk, Baltimore, Md.
7:00 P.M. Annual Smoker-Dinner (Stag).

Thursday, October 15

10:00 A.M.

TECHNICAL SESSION

"Pickling of Rod and Wire", Paper by *Walter G. See*, Sales & Service Mgr., Sub-

merged Combustion Co. of America, Hammond, Ind.

"Electric Patenting of Wire", Paper by *John P. Zur*, Met. Engr., Trauwood Engineering Company, Cleveland, Ohio.

1:30 P.M. Plant Inspection of Electric Patenting.

7:00 P.M. American Society for Metals Dinner.

American Institute of Mining and Metallurgical Engineers

Technical Sessions

Institute of Metals Division

Monday Afternoon, October 12

COPPER-BASE ALLOYS

Chairmen—CARL E. SWARTZ and F. N. RHINES

"Phase Diagram of the Copper-iron-silicon System from 90% to 100% Copper", by *A. G. H. Andersen*, Met. Engr., Oakdale, N. Y., and *W. A. Kingsbury*, Res. Met., Phelps Dodge Corp.

"Internal Friction of an Alpha Brass Crystal", by *Clarence Zener*, Assoc. Prof. of Physics, Washington State College; now at Watertown Arsenal.

"Note on Some Hardness Changes That Accompany the Ordering of Beta Brass", by *Cyril Stanley Smith*, Res. Supvr., War Metallurgy Comm., National Academy of Sciences, National Research Council.

Tuesday Morning and Afternoon, October 13

SYMPOSIUM ON RARE AND PRECIOUS METALS

Chairmen — W. P. SYKES and T. A. WRIGHT (Morning); E. M. WISE and C. B. SAWYER (Afternoon)

"Rare Metals and the War Effort", by *W. P. Sykes*, Consultant, Conservation Division, W.P.B.

"The Rare Metals and Why They Are Rare", by *R. S. Dean*, Asst. Director, U. S. Bureau of Mines.

"The Use of Silver During the Emergency", by *R. H. Leach*, Vice Pres., and *John L. Christie*, Metallurgical Manager, Handy and Harman.

"The Effect of Certain Elements on the Rate of Tarnishing of Silver Alloys", by *W. E. Campbell*, Research Chemist, Bell Telephone Laboratories.

"Bismuth Solders and Other New Applications of Bismuth", by *A. J. Phillips*, Supt., Research Dept., American Smelting and Refining Co.

"Elements a la Carte: A summary of the Status of Artificially Produced Elements and Some of Their Applications", by *K. K. Darrow*, Physicist, Bell Telephone Laboratories.

"Rare Elements in the Electrical Industry", by *Porter H. Brace*, Cons. Met., Research Lab., Westinghouse Electric and Manufacturing Co.

"Rare Elements in the Glass Industry", by *M. B. Vilensky*, Chief Met., Owens-Corning Fiberglas Corp.

"Notes on Refractory Metal-base Compound Materials", by *G. G. Goetzel*, Metallurgist, American Sinteel Co.

"Time-to-fracture Tests on Platinum, Platinum-iridium, and Platinum-rhodium Alloys", by *H. E. Strauss*, Research Physicist, Baker and Co., Inc.

Tuesday Evening, October 13

ANNUAL DINNER OF THE METALS DIVISIONS

Toastmaster—CARL E. SWARTZ, *Chairman, Institute of Metals Division*
Speaker—EARLE C. SMITH, *Chairman, Iron and Steel Division*

Wednesday Noon, October 14

INSTITUTE OF METALS DIVISION EXECUTIVE COMMITTEE LUNCHEON

Wednesday Afternoon, October 14

ALUMINUM, MAGNESIUM AND LEAD

Chairmen—E. E. SCHUMACHER and DANA W. SMITH

"The Rate of Precipitation of Silicon from the Solid Solution of Silicon in Aluminum," by *L. K. Jetter*, Aluminum Res. Lab., Aluminum Co. of America, and *Robert F. Mehl*, Dept. of Met., Carnegie Inst. of Tech.

"Equilibrium Diagrams and Lattice Spacing Relationships in the Systems Magnesium-tin and Magnesium-lead", by *Geoffrey V. Raynor*, Inorganic Chemistry Laboratory, The University Museum, Oxford, England.

"Constitution of Lead-rich Lead-antimony Alloys", by *W. S. Pellini*, Res. Asst., and *F. N. Rhines*, Member of Staff and Asst. Prof. of Met., Metals Res. Lab., Carnegie Inst. of Tech.

Iron and Steel Division

Monday Afternoon, October 12

MAGNETITE REDUCTION: CHROMIZING: WELDABILITY

Chairmen—L. S. BERGEN and A. B. KINZEL

"A Study of Low Temperature Gaseous Reduction of a Magnetite", by *M. C. Udy* and *C. H. Lorig*, Battelle Memorial Inst.

"Chromizing of Steel", by *I. R. Kramer* and *Robert H. Hafner*, Div. of Physical Met., Naval Research Lab., Washington, D. C.

"Calculated Hardenability and Weldability of Carbon and Low-alloy Steels", by *C. E. Jackson* and *G. G. Luther*, Div. of Physical Met., Naval Res. Lab., Anacostia Station.

Tuesday Morning, October 13

TENSILE PROPERTIES AND HARDENABILITY

Chairmen—J. HUNTER NEAD and G. R. BROPHY

"True Stress-strain Relations at High Temperatures by the Two-load Method", by *C. W. MacGregor*, Assoc. Prof. of Applied Mechanics, M.I.T., and *L. E. Welsh*, Engr., Bakelite Corp.

"The Calculation of the Tensile Strength of Normalized Steels from Chemical Composition", by *F. M. Walters, Jr.*, Dir. of Physical Met., Naval Res. Lab., Anacostia Station.

"Effect of Silicon on Hardenability", by *Walter Crafts* and *J. L. Lamont*, Union Carbide and Carbon Research Lab., Inc., Niagara Falls, N. Y.

Tuesday Noon, October 13

IRON AND STEEL DIVISION EXECUTIVE COMMITTEE LUNCHEON

Tuesday Afternoon, October 13

OPEN HEARTH STEEL

Chairmen—FRANK G. NORRIS and GILBERT SOLER

"Duplex Process for Manufacture of Basic Open-hearth Steel", by *H. B. Emerick* and *S. Feigenbaum*, Metallurgical Dept., Jones and Laughlin Steel Corp.

"The Effects of Tin on the Properties of Plain Carbon Steel", by *J. W. Halley*, Met., Inland Steel Co.

"Cause of Bleeding in Ferrous Castings", by *C. A. Zappfe*, Res. Met., Battelle Memorial Inst.

Tuesday Evening, October 13

ANNUAL DINNER OF THE METALS DIVISIONS

Toastmaster—CARL E. SWARTZ
Chairman, Institute of Metals Division
Speaker—EARLE C. SMITH
Chairman, Iron and Steel Division

Wednesday Afternoon, October 14

PHYSICAL CHEMISTRY OF STEEL MAKING

Chairmen—CHARLES R. HERTY, JR., and W. O. PHILBROOK

"Silicon: Oxygen Equilibria in Liquid Iron", by *C. A. Zappfe*, Res. Met., and *C. E. Sims*, Supervising Met., Battelle Memorial Inst.

"Equilibria of Liquid Iron and Simple Basic and Acid Slags in a Rotary Induction Furnace", by *C. R. Taylor*, Res. Engr., American Rolling Mill Co., and *John Chipman*, Prof. of Met., Mass. Inst. of Tech.

Thursday Noon, October 15

PHYSICAL CHEMISTRY OF STEEL-MAKING COMMITTEE LUNCHEON

Exhibitors in Finishing Industry

ADVANCE POLISHING WHEELS, INC., Chicago. Booth E-113.

ALOX CORP., Niagara Falls, N. Y. Booth B-516.

ALUMINUM CO. OF AMERICA, Pittsburgh. Booth C-421.

ALVEY FERGUSON CO., Cincinnati. Booth S-162.

AMERICAN FOUNDRY EQUIPMENT CO., Mishawaka, Ind. Booth D-340.

BAKER & CO., INC., Newark, N. J. Booth B-415.

BEHR-MANNING CORP., Troy, N. Y. Booth C-141.

BRIDGEPORT BRASS CO., Bridgeport, Conn. Booth D-411.

CARBORUNDUM CO., Niagara Falls, N. Y. Booth C-122.

CHASE BRASS & COPPER CO., Waterbury, Conn. Booth B-327.

CROWN RHEOSTAT & SUPPLY CO., Chicago. Booth A-310.

(Concluded on page 526)

Applications of Bipolarity in Plating†

By FRANK K. SAVAGE

Research Chemical Engineer,
C. G. Conn, Ltd.,
Elkhart, Ind.

Due to the scarcity of metal, it is important that every means be used for obtaining more uniform distribution of deposits in order to use less metal and still obtain minimum required thicknesses. The bipolar principle discussed in this article is particularly applicable in cases where either semi-automatic or full automatic plating is being done inasmuch as it obviates the need for expensive equipment required when the auxiliary anode principle is used. Although better results are obtained when an auxiliary anode is used, the simplicity of the use of the bipolar, intermediary electrode makes the use of this principle preferable in many cases. A short resume of the historical aspects of the principle is given and then practical applications are described.—Ed.

THE writer wishes to discuss what has become a useful tool in electroplating and has solved some plating problems which would otherwise be impractical, impossible or decidedly uneconomical.

The bipolar electrode as used in electroplating is, as the name implies, positive on the end nearest the cathode and negative on the end nearest the anode. It has no direct electrical connection to either the anode or the cathode. It is obvious that whenever any conductor is in a field of an electroplating bath between the anode and the cathode, a portion of the electrical current will follow it, the path of least resistance, in preference to traveling through the solution which is of greater resistance. The end nearest the anode will be plated upon and the end nearest the cathode will be corroded.

If the positive or anodic end of the bipolar electrode is of the same metal as that being plated, no solution contamination will result. The negative or cathodic end may be of any convenient metal. In some cases a metal which is insoluble as an anode in the solution may be advantageously used as bipolar material. Lead in chromium solutions, or steel in cyanide copper or silver solutions, are good examples of this.

The portion of the work surface nearest the bipolar electrode will become plated to a greater thickness than otherwise would result due to the fact that the bipolar electrode has afforded an easier passage for the electrical current to that point. This is illustrated in Fig. No. 1. In Sketch (a), a simple flat anode and cathode are shown with a bipolar electrode in place. Current lines are roughly sketched in, disregarding all effects except solution resistance. It may be seen that the most current is directed toward the center of the cathode.

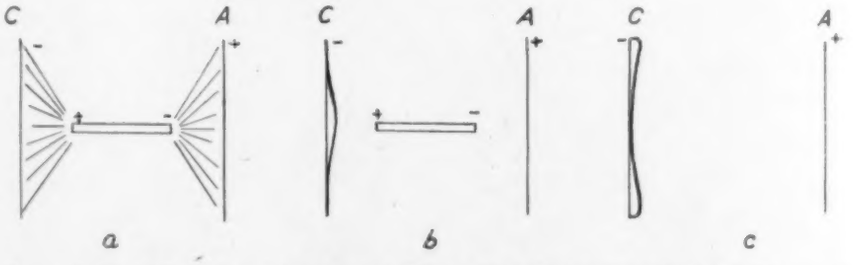


Fig. 1. Sketch "a", a simple, flat anode and cathode with a bipolar electrode; sketch "b", conception of the distribution of deposit with bipolar electrode; sketch "c", conception of distribution of plate without bipolar electrode.

Frank K. Savage

Sketch (b) gives a conception of the distribution of the cathode deposit which might be obtained. Sketch (c) gives an idea of the distribution which might be obtained without the bipolar electrode.

The author is sure that many readers have at one time or another witnessed some of the bad effects of bipolarity. One of the common troubles occurs in uninsulated steel tanks which may be used in the case of silver, zinc, cadmium, or cyanide copper plating. If the total distance from the anodes to the tank is less than the distance

† Reprinted from MONTHLY REVIEW, American Electroplaters' Society, pp. 301-308, April, 1942.

through the solution from anode to cathode, metal will be deposited upon the tank back of the anodes, and the portions of the tank nearest the work will act as insoluble anodes. The tank itself in this case is bipolar and unless the condition is corrected, it will in time greatly deplete the solution in metal, deposit a heavy layer of perhaps a valuable metal on the tank and in extreme cases will burn or otherwise cause undersirable work. The life of the tank itself may also be shortened.

Series Refining Uses Bipolarity Principles

Perhaps the earliest practical application of bipolarity in electroplating was the use of the principle in the series refining of copper. In about the year 1892 Hayden developed the series refining process in Bridgeport, Conn., which is the earliest application of the bipolar phenomenon in plating which the author is able to find. The series refining process for copper, which was further developed later, is still used as follows:

Smooth anodes of uniform thickness are cast, and about five of these are suspended in a row from an iron hanger bar. These rows are accurately spaced in tanks much deeper and wider and somewhat larger than other copper refining tanks. At a given period, the spacing may be such that about 100 to 125 rows are placed in a tank. Current is introduced at one end of the tank and travels from row to row through the electrolyte dissolving copper from one side of the next row. In other words, each tank is really made of from 100 to 125 depositing "cells" or electrolytic units. Starting sheets, as used in the multiple system, are eliminated; spacing can therefore be much closer.

There are at least 2 copper refineries at the present time which still use this system of refining. Its general use is prohibited by other drawbacks which make it more advisable to use the multiple system.

Early Use of Bipolarity

In 1931 a patent was taken out by Ernest Wurth of Goppingen, Germany, wherein the use of bipolarity was described, to obtain by electrodeposition, metal layers of uniform thickness on the inside of hollow shapes such as the inside of long bars of channel or other "U" or "C" shaped sections, the interiors of which are accessible through a narrow slot. In this process Mr. Wurth used a long, thin bar of metal, one edge of which extended out parallel to the anodes. This bipolar electrode was of the same metal as that which was being plated and as the cathodic or negative side of the bipolar strip became heavy in metal, due to being deposited upon, he reversed the position in the tank so that it became anodic; thus he was able to use it for a much longer time than would otherwise have been possible.

The bipolar electrode was suspended in the long slot by means of insulating spacing blocks which prevented it from becoming electrically connected to either the anode or the cathode.

In 1939 a patent was granted to Charles W. Yerger and Guerin Todd, wherein the bipolar principle was used for an electrolytic treatment of strip steel, which consisted of electrolytic pickling and bright dipping. In this process the strip steel itself was made bipolar by running it through a solution between an anode and a cathode. The side of the strip nearest the anode was cleaned cathodically and conversely the side nearest the cathode was cleaned anodically. The polarity of the steel was changed by reversing the electrodes either in the same tank or in different tanks.

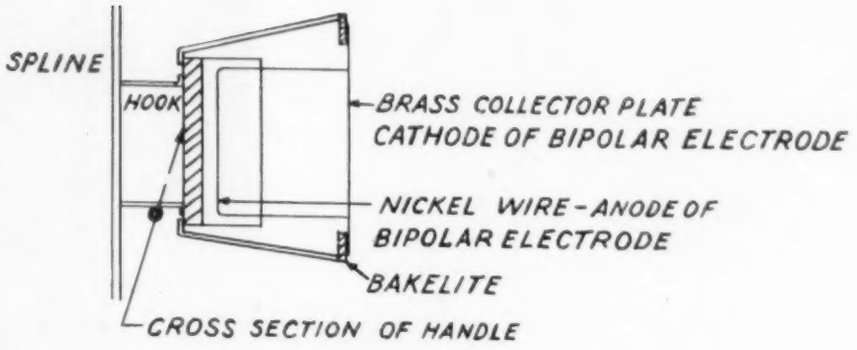


Fig. 2. Arrangement of bipolar electrode for nickel plating of a latch handle.

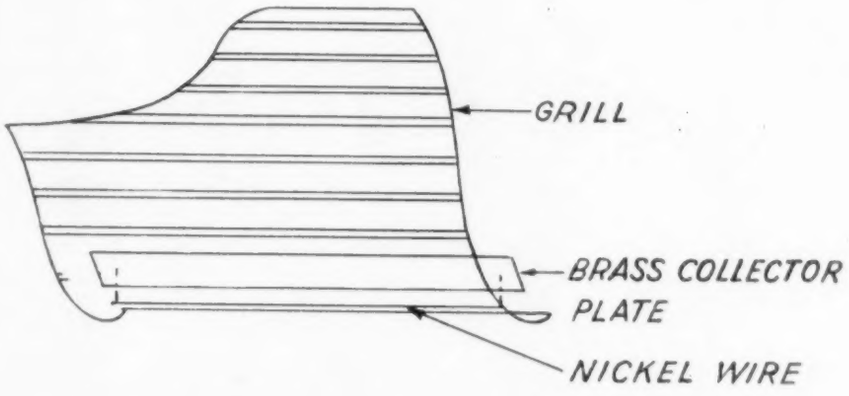


Fig. 3. Use of bipolar electrode for plating recessed section of a radiator grille.

Applications of Bipolarity

On September 5, 1941, C. F. Nixon of the Ternstedt Mfg. Co. described several interesting applications of bipolarity as an aid to the practical plater, before the Detroit Branch of the American Electroplaters' Society. I shall attempt to describe with the aid of sketches these, as well as other applications which have come to my attention.

One application Mr. Nixon described was a latch handle wherein current distribution in nickel plating was obtained on the inside by using an arrangement as shown in Fig. 2. The collector plate must be large enough and close enough to the anode to collect sufficient current to give the

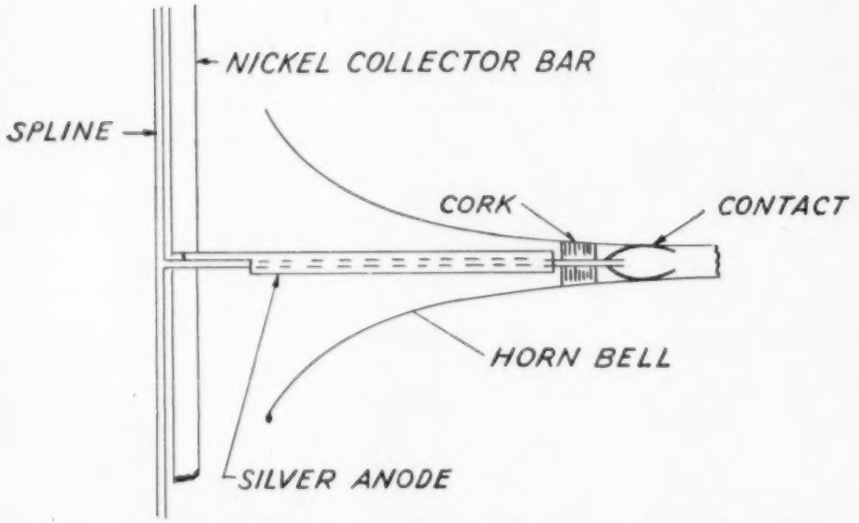


Fig. 4. Sketch of a bell section of a trombone to be silver plated in an automatic machine.

desired metal distribution in the recess.

Another application Mr. Nixon described was in plating radiator grille sections. At the bottom of this particular grille there was a recessed section as shown in Fig. 3. In order to obtain proper metal distribution, an auxiliary anode arrangement was used as shown on the sketch. Sufficient current density was obtained in the recessed area, by use of the bipolar electrode, to obtain the desired minimum plate thickness and to produce a bright plate.

We have used the bipolar principle for some time in band instrument processing. Fig. 4 is a sketch of the bell section of a trombone. At the time we went to automatic silver plating, it was impossible to place these very deeply recessed bell sections facing an anode as we had previously done in the hand operated process. We immediately had trouble throwing into the bells which were often a foot deep. A collector bar of pure nickel was placed on the rack parallel to, and insulated from, the hollow spline of the rack. A thin strip of silver was bolted to the collector bar and wrapped around the insulated rack member which supported the bell. This silver strip extended to the cork on the inside of the bell. In operation the nickel cathodic section of the bipolar electrode was plated upon and sufficient current was conducted to the silver anodic member to successfully plate the inside of the bell. When the nickel strips become heavily plated with silver they are removed and stripped. Periodically as the silver corrodes it is renewed from thin pieces of used anodes.

An interesting side light of this particular plating method is the fact that the horn bells are hollow and solution must be excluded to protect the inside. Ports and tone holes are corked tightly and the hollow supporting member and spline of the rack equalizes the air pressure on the inside of the horn by extending above the solution level. No vacuum or pressure can form during transfer between solutions of different temperature which would otherwise blow out corks or draw in solution. It also may be seen that the contact is beyond the cork at a spot which is not plated. This does away with contact marks which are often a problem on high class merchandise.

We have used the bipolar principle in several other cases where current distribution was a problem. Band instruments lend a remarkable field for current distribution studies. It is possible to apply bipolar electrodes to practically all ordinary plating processes.

Wherever it is possible and practical to use an auxiliary or inside anode electrically connected to the positive side of the current supply, superior results may be obtained. However, in many cases the bipolar electrode may be utilized with less cost and less time consumed. This is especially true in semi or full automatic plating where extra anode rails, contact fingers and rack contacts are expensive and sometimes very awkward.

The bipolar electrode is one more tool that may be used to obtain minimum thickness requirements in recesses without so much wasteful heavy plating on exposed sections. In these days of extreme metal shortage every tool at our disposal should be used to conserve metal from both an economic and a patriotic standpoint.

(*Concluded from page* 523)

DESPATCH OVEN CO., Minneapolis. Booth A-415.

DETROIT REX PRODUCTS CO., Detroit. Booth D-311.

E. I. DU PONT DE NEMOURS & CO., Wilmington, Del. Booth D-134.

J. B. FORD CO., Wyandotte, Mich. Booth C-117.

GLOBE MACHINE & STAMPING CO., Cleveland. Booth B-335.

HAMMOND MACHINERY BUILDERS, INC., Kalamazoo, Mich. Booth D-122.

HANDY & HARMAN, New York. Booth D-314.

HEIL & CO., Cleveland. Booth A-332.

A. F. HOLDEN CO., New Haven, Conn. Booth B-147.

E. F. HOUGHTON & CO., Philadelphia. Booth D-137.

INDEPENDENT PNEUMATIC TOOL CO., Chicago. Booth C-314.

INTERNATIONAL NICKEL COMPANY, INC., New York. Booth C-111.

MALL TOOL CO., Chicago. Booth D-321.

P. R. MALLORY & CO., INC., Indianapolis. Booth A-500.

MANHATTAN RUBBER MANUFACTURING CO., Passaic, N. J. Booth D-323.

MATCHLESS METAL POLISH CO., Chicago. Booth E-113.

METAL FINISHING. Booth B-526. See Metal Industry Publishing Co.

METAL INDUSTRY PUBLISHING CO., New York. Booth B-526.

MORRISON ENGINEERING CO., Cleveland. Booth A-414.

NORTON CO., Worcester, Mass. Booth C-138.

OAKITE PRODUCTS, INC., New York. Booth E-134.

OHIO CARBON CO., Cleveland. Booth C-328.

OSBORN MANUFACTURING CO., Cleveland. Booth B-427.

PANGBORN CORP., Hagerstown, Md. Booth C-130.

PARK CHEMICAL CO., Detroit. Booth S-112.

PHILLIPS MANUFACTURING CO., Chicago. Booth C-327.

PORTER-CABLE MACHINE CO., Syracuse, N. Y. Booth A-519.

N. RANSOHOFF, INC., Cincinnati. Booth B-311.

REVERE COPPER & BRASS CO., New York. Booth B-306.

ROLOCK, INC., Fairfield, Conn. Booth S-132.

SPARKLER MANUFACTURING CO., Mundelein, Ill. Booth A-523.

Chromic Acid Anodizing Baths†

Interpretation of Glass Electrode Measurements

By WINSLOW H. HARTFORD

Mutual Chemical Company of America, Baltimore, Md.

pH measurements of anodizing baths and similar solutions indicate unusually high hydrogen ion activity, which is further increased abnormally as the concentration of trivalent ion or of chromic acid is increased. This effect is of importance in the proper control of anodic baths. Measurements of the trivalent perchlorates show that the effect persists in dilutions as low as 0.001 molal and is probably due, not to rearrangement of complexes with liberation of acid, but rather to activity effects arising from the high ionic strength and asymmetric valence type of the solutions. Determination of the hydrolysis constant of the perchlorates has been employed as a check on the measurements.

Of the compounds studied, chromic dichromate has been shown to possess exceptionally high hydrogen ion activity in solution, which further increases with the passage of time. This serves to confirm the existence of the complex structure previously ascribed to the compound. A similar complex structure exists to a lesser extent in the case of aluminum dichromate.

SOLUTIONS of chromic acid find use in the anodic treatment of aluminum. When first prepared, these solutions are substantially pure chromic acid, but on use, aluminum and possibly trivalent chromium appear in increasing amounts. Since aluminum and chromic dichromates are usually assumed to be the compounds formed,[1, 8] solutions having that composition were used for study, chromic acid being added to approximate the compositions encountered in practice. The results observed when these solutions are tested with a glass-electrode pH meter present peculiarities; the purpose of this paper is to describe and, in so far as possible, to interpret these peculiarities. As the complex nature of these solutions renders examination of their properties by physicochemical calculations difficult, solutions of chromic and aluminum perchlorate were also prepared and studied.

Apparatus and Materials

The glass electrode measurements were made on a Beckman pH meter. Although the pH readings given by glass-electrode pH meters with solutions containing chromic acid at low pH may vary considerably with different electrode assemblies[7], measurements made with any single instrument are consistent. Since the readings obtained were used for comparison only, no corrections were made. Measurements in all cases were made at temperatures within 2° of 25° C., the effect of this change in temperature has been shown to be less than the precision of the measurements, 0.02 pH.

The chromic acid used was technical flakes, testing 99.8 per cent CrO_3, 0.04 per cent SO_4, and 0.017 per cent Cr_2O_3. The behavior of this material has been shown to be identical with that of C. P. chromic acid[7].

Chromic dichromate solutions were prepared by reducing chromic acid with 30 per cent hydrogen peroxide until more than 25 per cent of the chromium was in the trivalent condition, boiling to destroy peroxide, analyzing for Cr^{VI} and Cr^{+++}, and adjusting to the composition of chromic dichromate by adding chromic acid.

Aluminum dichromate solutions were prepared by treating chromic acid with an excess of carefully washed hydrous alumina, filtering, oxidizing electrolytically any Cr^{+++} present, analyzing, and adjusting to the composition $Al_2(Cr_2O_7)_3$ by addition of the calculated quantity of CrO_3.

Perchloric acid solutions were prepared by diluting C. P. perchloric acid to approximately the strength desired and then analyzing for acid content.

Chromic perchlorate solution was prepared by completely reducing chromic acid with hydrogen peroxide in the presence of the calculated quantity of perchloric acid, the solution being kept dilute to prevent possible reduction of perchloric acid. The solution was then boiled to destroy excess peroxide and analyzed for Cr^{+++} and perchloric acid. No chloride was present in the finished solution.

Aluminum perchlorate solution was prepared by treating hydrous aluminum oxide with the calculated quantity of perchloric acid. The composition of the solution was checked by analysis before use.

Chromic Acid, Chromic Dichromate, and Aluminum Dichromate

The following pH readings for the chromic acid used in this work are quoted[7] and are shown in Figure 1:

CrO_3, mole/l.	1.00	0.50	0.20
pH, 25° C.	0.10	0.40	0.79
0.10	0.05	0.02	0.01
1.09	1.39	1.80	2.08

pH readings were obtained for solutions of chromic dichromate and aluminum dichromate, as indicated in Table I. The solutions were prepared by dilution of the most concentrated

† Reprinted from Industrial and Engineering Chemistry, Industrial Edition *34*, 920-924 (Aug. 1, 1942).

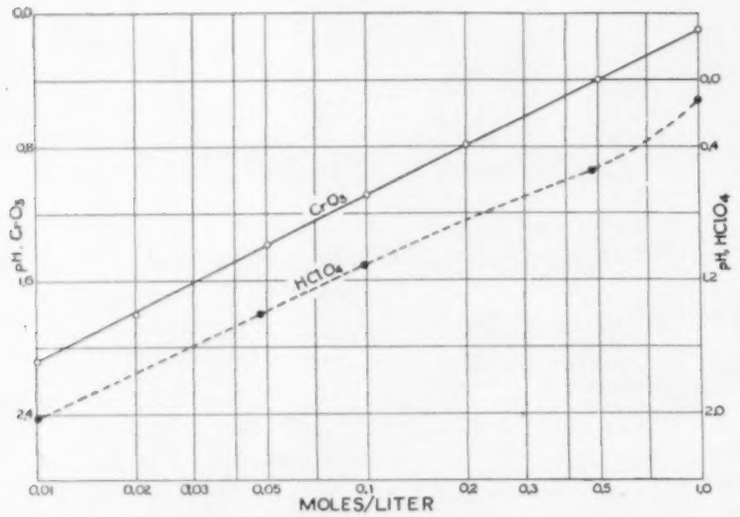


Fig. 1. pH of chromic and perchloric acids at various concentrations, 25° C.

solution. Concentration of the dilute solutions gave check results and indicated complete reversibility of the dilution effects. Buzzard and Wilson[1] assumed that the free chromic acid content of such solutions is determined by the pH reading. Using this assumption, an apparent ratio of combined Cr^{VI}/Cr^{+++} or combined Cr^{VI}/Al^{+++} was calculated according to the relationship:

$$\text{apparent ratio} = \frac{Cr^{VI} - \text{free } Cr^{VI} \text{ from pH}}{Cr^{+++} \text{ or } Al^{+++}}$$

Table I shows that at concentrations above 0.05 *M*, the apparent ratio of Cr^{VI} to Cr^{+++} or Al^{+++} decreases rapidly with increase in concentration. This is equivalent to stating that the pH readings are lower than were expected in these solutions, due either to (*a*) increased hydrolysis or complex anion formation, with liberation of chromic acid, or (*b*) greatly increased activity of the hydrogen ion in these solutions as a consequence of the high ionic strength and complex interionic forces.

Table II gives the results of a series of experiments in which known amounts of chromic acid were added to chromic dichromate and aluminum dichromate solutions. The apparent ratio of Cr^{VI} to Cr^{+++} or Al^{+++} was calculated as in Table I, and the expected pH was also calculated on the basis of an increase in apparent free chromic acid equal to that added. An additional decrease in pH was noted which, although nearly independent of the chromic acid added, in the range studied is roughly proportional to the concentration of trivalent ion; this indicates that these ions, with their high ionic strength, are the primary cause of the effects noted. It is therefore unlikely that the pH is a true measure of the chemically uncombined chromic acid, although pH has been found of importance in predicting the electrochemical behavior of these solutions[17].

Similarly the apparent ratio of Cr^{VI} to Cr^{+++} and Al^{+++}, while mathematically a function of the composition of the solution, is determined within experimental error through measurement of pH. This relation, shown graphically in Figure 2, is apparent from examination of Tables I and II.

pH measurements were also made on a large number of solutions of similar composition, prepared by various methods. Trivalent chromium was introduced by means of thermal decomposition, electrolytic reduction, and reduction with hydrogen peroxide, methyl alcohol, and oxalic acid; aluminum was introduced through dissolving pure aluminum powder in chromic acid, followed by electrolytic oxidation, and through the anodic oxidation of aluminum plates. In all cases exceptionally high hydrogen ion activity was noted, and the relation shown in Figure 2 was found to hold closely.

Solutions were allowed to stand at room temperature until a constant pH value was obtained. This usually required from 6 to 24 hours. A general tendency was noted for the pH to decrease on standing, indicating a gradual rearrangement of the structure of the solute. This effect was particularly pronounced with chromic dichromate solutions.

Although the results obtained indicate that the effects described result from the high ionic strength of these solutions, nevertheless the complex nature of the dichromates of trivalent metals does not rule out the possibility that hydrogen ion is liberated through a rearrangement of complexes in the more concentrated solutions. Accordingly, measurements were made in an analogous manner with perchloric acid, chromic perchlorate, and aluminum perchlorate. Perchloric acid was chosen since it cannot form anionic complexes of itself, and since

TABLE I

pH of Chromic and Aluminum Dichromate Solutions

Concn., Mole/Liter				Apparent Ratio, Combined
$Cr_2(Cr_2O_7)_3$	Cr^{+++}	Cr^{VI}	pH	Cr^{VI}/Cr^{+++}
0.357	0.714	2.142	0.23	1.97
0.1785	0.357	1.071	0.68	2.27
0.0892	0.1785	0.536	1.04	2 37
0.0446	0.0892	0.268	1.39	2.45
0.0223	0.0446	0.134	1.67	2.42
0.0112	0.0223	0.0669	1.95	2.36

Concn., Mole/Liter				Apparent Ratio, Combined
$Al_2(Cr_2O_7)_3$	Al^{+++}	Cr^{VI}	pH	Cr^{VI}/Al^{+++}
0.682	1.364	4.092	0.18	2.40
0.341	0.682	2.046	0.92	2.78
0.1705	0.341	1.023	1.44	2.87
0.0853	0.1705	0.512	1.82	2 90
0.0426	0.0853	0.256	2.14[a]	2.90
0.0213	0.0426	0.128	2.43[a]	2.90
0.0107	0.0213	0.064	2 72[a]	2.90

[a] Values for free Cr^{VI} estimated by extrapolation.

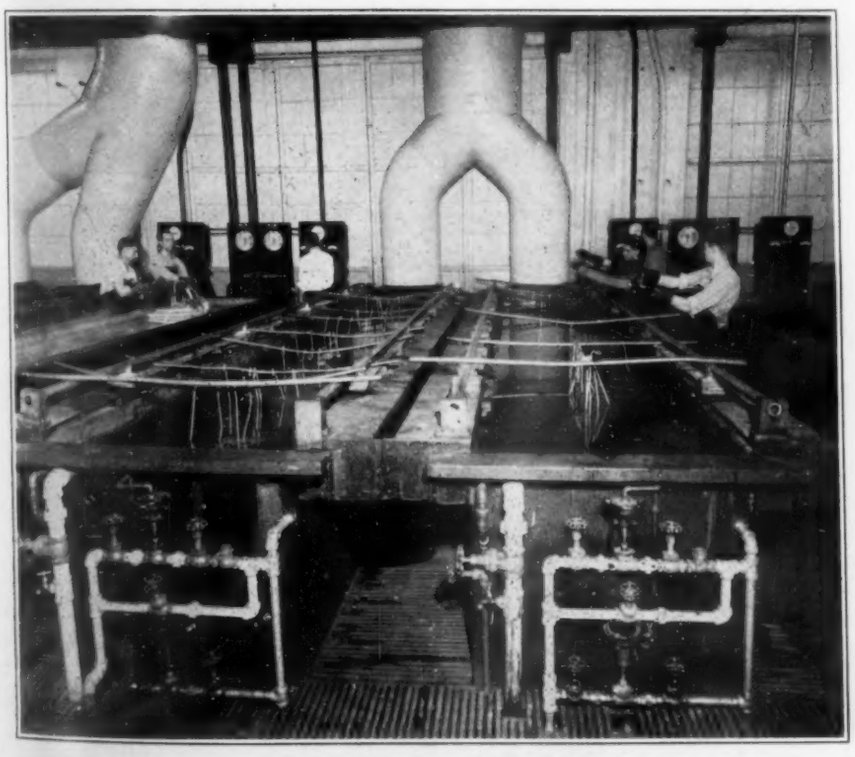
TABLE II

Effect of Adding Chromic Acid to Dichromate Solutions

Concn., Mole/Liter				pH Values			Apparent Ratio, Combined
$Cr_2(Cr_2O_7)_3$	Added CrO_3	Cr^{+++}	Total Cr^{VI}	Obsvd.	Calcd.	Decrease	Cr^{VI}/Cr^{+++}
0.1785	0	0.357	1.071	0.68	...		2.27
0.1785	0.100	0.357	1.171	0.48	0.54	0.06	2.14
0.1785	0.200	0.357	1.271	0.31	0.43	0.12	1.87
0.1785	0.400	0.357	1.471	0.16	0.28	0.12	1.71
0.0892	0	0.1785	0.536	1.04	...	...	2.37
0.0892	0.100	0.1785	0.636	0.70	0.76	0.06	2.19
0.0892	0.200	0.1785	0.736	0.52	0.60	0.08	2.06
0.0892	0.400	0.1785	0.936	0.31	0.39	0.08	1.85
0.0446	0	0.0892	0.268	1.39	...	...	2.45
0.0446	0.100	0.0892	0.368	0.88	0.92	0.04	2.32
0.0446	0.200	0.0892	0.468	0.65	0.69	0.04	2.16
0.0446	0.400	0.0892	0.668	0.40	0.44	0.04	1.98

Concn., Mole/Liter				pH Values			Apparent Ratio, Combined
$Al_2(Cr_2O_7)_3$	Added CrO_3	Al^{+++}	Total Cr^{VI}	Obsvd.	Calcd.	Decrease	Cr^{VI}/Al^{+++}
0.256[a]	0	0.512	1.536	1.17			2.84
0.256	0.100	0.512	1.636	0.59	0.83	0.24	2.58
0.256	0.200	0.512	1.736	0.39	0.64	0.25	2.41
0.256	0.400	0.512	1.936	0.16	0.41	0.25	2.10
0.128[a]	0	0.256	0.768	1.64			2.89
0.128	0.100	0.256	0.868	0.84	0.98	0.14	2.70
0.128	0.200	0.256	0.968	0.59	0.73	0.14	2.54
0.128	0.400	0.256	1.168	0.34	0.47	0.13	2.46
0.064[a]	0	0.128	0.384	1.97			2.90
0.064	0.100	0.128	0.484	0.97	1.04	0.07	2.76
0.064	0.200	0.128	0.584	0.70	0.76	0.06	2.65
0.064	0.400	0.128	0.784	0.42	0.48	0.06	2.45

[a] Interpolated from data in Table I.



Typical chromic acid anodizing baths.

its aluminum and chromic salts yield aluminum ion and the simple violet chromic ion at room temperature[15]. Perchloric acid also lends itself better to study of dilute solutions, since insoluble basic chromates precipitate from the dichromate solutions at pH values above 3.

Perchloric Acid, Chromic Perchlorate, and Aluminum Perchlorate

The following pH readings were determined for perchloric acid and are plotted in Figure 1:

$HClO_4$, mole/l.	0.9824	0.4743	0.09824
pH, 25° C.	0.12	0.54	1.11
$HClO_4$, mole/l.		0.04743	0.01000
pH, 25° C.		1.40	2.03

Similarly, measurements were obtained for chromic and aluminum perchlorate solutions in this pH range, and calculated to give an apparent combining ratio as with the dichromate. The results are given in Table III.

The same behavior is observed here as that noted with chromic dichromate and aluminum dichromate—namely, a lowered apparent combining ratio of anion to cation with lowered pH, or an increase in apparent hydrolysis with decreasing pH. Consideration of the nature of hydrolysis indicates that the increase cannot be real. The possibility of rearrangement of a dichromate complex, which existed with the dichromates, is very unlikely since the perchlorates, which cannot form such a complex, behave similarly. Therefore, it is concluded that the low pH values result from activity effects caused by the high ionic strength and asymmetric valence type of these solutions. The pH values obtained in these solutions do not, therefore, connote "free acid", as originally postulated[1].

The liquid junction errors in these solutions may also be considerable and may distort the results. Accordingly, the simplest case, that of aluminum and chromium perchlorate, was studied by pH measurements at low ionic strength at 25° ± 0.5° C. The hydrolysis constant, expressed in terms of concentration, was evaluated at various concentrations, by allowing for the activity coefficient of hydrogen ion at various ionic strengths, μ, as determined by Scatchard[16]. The results are shown in Table IV where

TABLE III

pH of Chromic and Aluminum Perchlorate Solutions

$Cr(ClO_4)_3$, Mole/L.	pH, 25° C.	Apparent Ratio, ClO_4^-/ Cr^{+++}	$Al(ClO_4)_3$, Moles/L.	pH, 25° C.	Apparent Ratio, ClO_4^-/ Al^{+++}
0.714	0.52	2.30	1.356	0.02[a]	2.19
0.357	1.19	2.78	0.678	1.11	2.85
0.1785	1.70	2.87	0.339	1.70	2.94
0.0892	2.11[a]	2.92	0.1695	2.27[a]	2.97

[a] Values for free ClO_4^- estimated by extrapolation.

TABLE IV

Hydrolysis of Aluminum and Chromic Perchlorates

$Cr(ClO_4)_3$ Molality	pH	(H^+)	μ	γH^+	$[H^+]$	K'
0.00714	2.95	1.12×10^{-3}	0.040	0.873	1.28×10^{-3}	2.80×10^{-4}
0.00357	3.12	7.59×10^{-4}	0.020	0.896	8.47×10^{-4}	2.63×10^{-4}
0.001785	3.30	5.01×10^{-4}	0.010	0.918	5.46×10^{-4}	2.41×10^{-4}
0.001142	3.43	3.72×10^{-4}	0.006	0.933	3.99×10^{-4}	2.14×10^{-4}
0.000571	3.61	2.45×10^{-4}	0.003	0.949	2.58×10^{-4}	2.13×10^{-4}
0.000286	3.80	1.59×10^{-4}	0.0014	0.967	1.64×10^{-4}	2.20×10^{-4}
$Al(ClO_4)_3$						
0.00339	3.71	1.95×10^{-4}	0.019	0.898	2.17×10^{-4}	1.48×10^{-5}
0.001695	3.89	1.29×10^{-4}	0.010	0.918	1.41×10^{-4}	1.28×10^{-5}
0.000848	4.06	8.71×10^{-5}	0.005	0.937	9.30×10^{-5}	1.15×10^{-5}
0.000424	4.22	6.03×10^{-5}	0.0025	0.952	6.34×10^{-5}	1.12×10^{-5}

TABLE V

Effect of Added Salts on pH of Chromic Perchlorate Solution

Molality			
$Cr(ClO_4)_3$	$NaClO_4$	μ	pH
0.001785	0.000	0.010	3.30
0.001785	0.010	0.020	3.34
0.001785	0.030	0.040	3.37
0.001785	0.070	0.080	3.40
$Cr(ClO_4)_3$	$[Co(NH_3)_6]Cl_3$		
0.001785	0.00167	0.020	3.28
0.001785	0.00333	0.030	3.26

$$K' = \frac{[H^+]^2}{m - [H^+]} = \frac{[H^+]\,[MOH^{++}]}{[M^{+++}]}$$

Activities are denoted by parentheses, concentrations by brackets.

Other measurements showed that the values of K' became rapidly greater as the concentration increased. Thus, at 0.01428 M $Cr(ClO_4)_3$, $K' = 3.76 \times 10^{-4}$, and at 0.01695 M $Al(ClO_4)_3$, $K' = 2.12 \times 10^{-5}$. It is therefore apparent that the phenomenon of increased H^+ activity with increasing trivalent ionic concentration is noticeable with these solutions even at ionic strengths as low as $\mu = 0.01$. The effect appears to be produced by the trivalent ions, since additions of $NaClO_4$ to $Cr(ClO_4)_3$ solutions produce the expected slight increase in pH, whereas addition of $[Co(NH_3)_6]Cl_3$, prepared according to directions given by King[9], produced a slight decrease in pH. Hexamminocobaltic chloride was used since it is but little hydrolyzed. The sample had a pH of 5.20 in 0.0066 M solution. The results are shown in Table V.

Extrapolation of the values for K' given in Table IV to zero ionic strength gives approximate values for the hydrolysis constant of Cr^{+++} and Al^{+++}. Limitations of the equipment introduce errors as indicated:

$$K_0 = \frac{(CrOH^{++})\,(H^+)}{(Cr^{+++})} = (2.2 \pm 0.3) \times 10^{-4}$$

$$K_0 = \frac{(AlOH^{++})\,(H^+)}{(Al^{+++})} = (1.1 \pm 0.1) \times 10^{-5}$$

These values agree in magnitude with the very accurate value of $K_0 = 1.58 \times 10^{-4}$ given for hexaaquochromic chloride by Lamb and Fonda[10] and with the value $K_0 = 1.4 \times 10^{-5}$ quoted by Mellor[12] from the work of Denham and van Pelt for aluminum chloride, and serve as a confirmation of the pH values obtained.

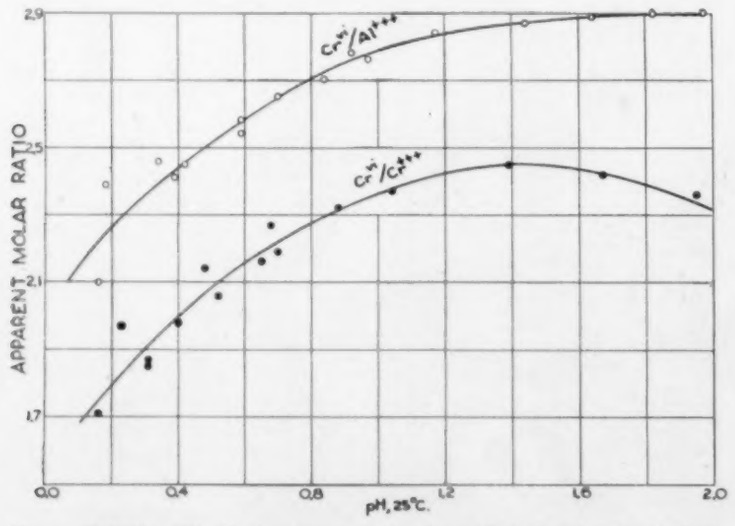


Fig. 2. Variation with pH of apparent ratio of hexavalent chromium to trivalent chromium and hexavalent chromium to aluminum.

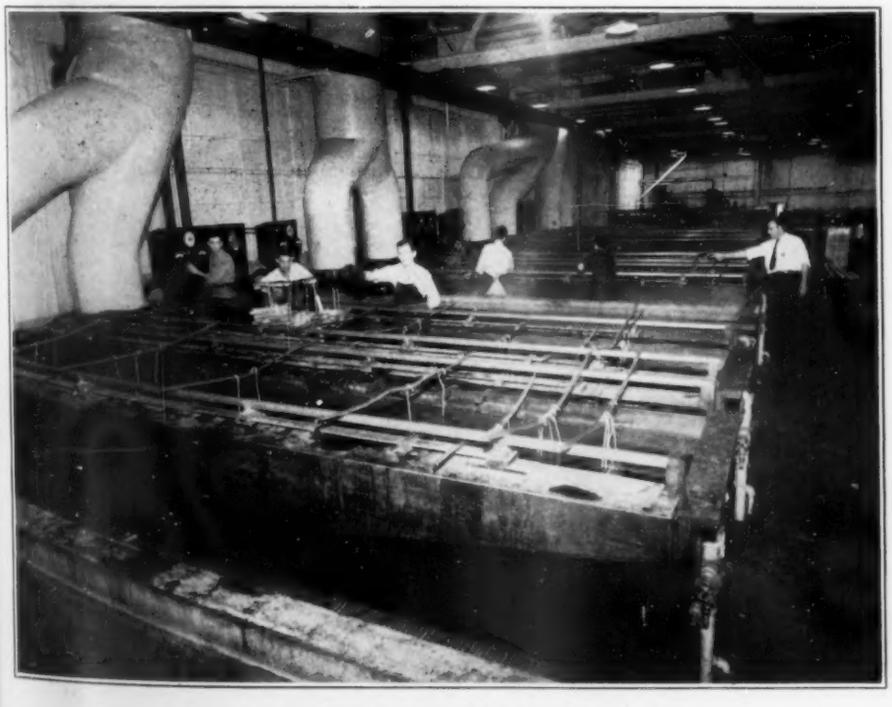
Discussion

The data presented show that, in the case of the four substances studied, increasing concentration causes an increase in hydrogen ion activity which is greater than that anticipated. The effect is nearly proportional to the trivalent ion concentration in concentrated solutions, and has been shown to be caused by addition of other trivalent ions in dilute solution. Such increases have been noted to a lesser extent by Lamb and Jacques[11] in their study of the hydrolysis of ferric chloride by conductometric methods and by Cupr[4] in quinhydrone electrode studies of the hydrolysis of various aluminum salts. It has been shown that, since the perchlorates behave similarly to the dichromates, the results observed are probably caused by the high ionic strength of the solu-

tion rather than by any liberation of acid in the more concentrated solutions. It is therefore incorrect to assume that either pH or chemical analysis (with aluminum oxide and chromic oxide considered combined as a slightly hydrolyzed dichromate) is a true measure of the chemically uncombined chromic acid in these solutions. In dilute solutions of the perchlorates, a similar increase in hydrogen ion activity has been observed at concentrations as low as 0.001 molal. Although the ionic strength of these solutions is quite low, no quantitative explanation of the results can be presented. The unsymmetric valence effect described by La Mer and Mason[12] may form the basis for a logical explanation.

In addition to the high hydrogen ion activity common to all these solutions at high concentration, the solutions of chromic dichromate (and, to a lesser extent, aluminum dichromate) show changes in pH on standing, the pH decreasing with time. Early studies of this compound[5, 6, 14] postulated an undissociated solute or colloid; but the high hydrogen ion activity points to a highly ionized solute, while the slow changes in pH on standing give indication of a rearrangement of a complex solute. Kasper[8] gave data consistent with the existence in concentrated chromic acid solutions of the complex, $Cr[Cr(Cr_2O_7)_3]$, which was recently prepared by Chaudhury[3] who also obtained a complex chromate, $Cr[Cr(CrO_4)_3]$, which exists in solution at pH 2.8[2]. Finally at pH 3-3.5 the colloidal basic chromate $Cr_2(OH)_4CrO_4$ forms. This compound was reported by Ollard[14] and has since been observed by Kasper[8] and the author. In view of the ease with which complex chromichromates form, even in highly acid solution, it is concluded that in chromic dichromate (and, to a lesser extent, in aluminum dichromate) solutions, there exists a progressive hydrolysis in which the two chromate complexes described above form from the dichromate complex. In complete accord with this hypothesis is the low pH at equilibrium of chromic dichromate solutions, as compared to the other compounds studied. No change in pH with time was observed with the perchlorate solutions, confirming the original assumption that they would be free from complex formation.

Since anodic oxidation is a result of the potential of oxygen discharge at the anode, which in turn is a function of hydrogen ion activity, pH would be expected to be an important variable in the control of anodic baths. This has been shown to be the case[1, 17]. However, since baths high in chromic acid and aluminum content have been shown to possess proportionately greater hydrogen ion activity, consideration must be given to this fact in determining the most economical operation of the anodic bath. The laboratory work of Tarr, Darrin, and Tubbs[17] has considered this point thoroughly, and the work has been confirmed by service records of anodic baths in commercial operations[18].



Equipment for chromic acid anodizing in a large factory.

Acknowledgment

The author wishes to express his appreciation to O. F. Tarr and Marc Darrin, of the Mutual Chemical Company staff, for their assistance and suggestions. Many thanks are due also to Walter C. Schumb of Massachusetts Institute of Technology for suggestions during the early part of the work, and especially to Charles Kasper of the National Bureau of Standards for his help with the manuscript and valuable suggestions.

Literature Cited

1. Buzzard, R. W., and Wilson, J. H., "J. Research Natl. Bur. Standards", **18**, 53, (1937); Research Paper **961**.

2. Chaudhury, P. C. R., "J. Indian Chem. Soc.", **16**, 652 (1939).

3. Ibid., **18**, 102 (1941).

4. Cupr, V., "Collection Czechoslov. Chem. Commun.", **1**, 467 (1929).

5. Ewing, D. T., Hardesty, J. O., and Kao, T. H., Mch. Eng. Expt. Sta., Bull, **18** (1928).

6. Haring, H. E., "Chem. & Met. Eng." **32**, 692 (1925).

7. Hartford, W. H., "Ind. Eng. Chem." Anal. Ed., **14**, 174 (1942).

8. Kasper, C., "Bur. Standards J. Research", **9**, 353 (1932); Research Paper **476**.

9. King, A., "Inorganic Preparations", p. 104, New York, D. Van Nostrand Co., 1936.

10. Lamb, A. B., and Fonda, G. R., "J. Am. Chem. Soc.", **43**, 1154 (1921).

11. Lamb, A. B., and Jacques, A. G., Ibid., **60**, 1215 (1938).

12. La Mer, V. K., and Mason, C. F., Ibid., **49**, 410 (1927).

13. Mellor, J. W., "Comprehensive Treatise on Inorganic and Theoretical Chemistry", Vol. 11, p. 385, New York, Longmans, Green and Co., 1922.

14. Ollard, E. A., "J. Electroplaters' Depositors' Tech. Soc.", **3**, 5 (1929).

15. Roth, R., "Zur Kenntnis der Perchlorate", München, 1910.

16. Scatchard, G., "J. Am. Chem. Soc.", **47**, 696 (1925).

17. Tarr O. F., Darrin, M., and Tubbs, L. G., "Ind. Eng. Chem.", **33**, 1575 (1941).

18. Tubbs, L. G., and Hartford, W. H., private communications.

Patents

Cleaning Apparatus

U. S. Pat. 2,294,789. E. A. Matteson and K. B. Bowman, assignors to The Aetna Standard Engineering Co., Sept. 1, 1942. A strip cleaning apparatus of novel design including rotatable scrubbing brushes and means of spraying hot alkali on the strip.

Coating Aluminum

U. S. Pat. 2,294,717. C. R. Carney, Sept. 1, 1942. A method of sealing anodized aluminum surfaces which comprises immersion in a mixture of 1 part by weight of carnauba wax and 12 parts by weight of xylol at 150°-170°F., to allow the mixture to penetrate the pores, air drying the treated surface and then heating to 260°-280°F. to drive off any remaining solvent and to fuse the wax into a continuous coating.

Hot Galvanizing Pot

U. S. Pat. 2,294,490. O. C. Trautman, Sept. 1, 1942. An apparatus for hot galvanizing and the like consisting of an inner and outer pot of welded steel sheet of novel design.

Soft Solder

U. S. Pat. 2,293,602. E. J. Ferguson, assignor to North American Smelting Co., August 18, 1942. A lead base solder consisting of 1.5-3% silver, 0.5-5% antimony and the balance substantially lead and impurities.

Strip Plating

U. S. Pat. 2,293,378. W. S. Allen and H. G. Bargfeldt, assignors to Carnegie-Illinois Steel Corp., August 18, 1942. A conductor roll for supplying current to metal strip being treated continuously in an electrolytic bath.

Metal Spraying

U. S. Pat. 2,293,062. H. S. Ingham, assignor to Metallizing Engineering Co., Inc., August 18, 1942. A process of making negatives of a matrix by spraying with a metal having a softening and melting point higher than that of the matrix material.

Coloring Aluminum and Alloys

U. S. Pat. 2,290,364. M. Tosterud, assignor to Aluminum Co. of America, July 21, 1942. Light yellow to dark brown colors are produced on anodized aluminum in a solution containing ferric oxalate. The colors are light fast and the aluminum may be oxidized previously in either chromic acid or preferably in sulfuric acid.

Example: Anodize the aluminum in 15% sulfuric acid at 12 amp./sq. ft. for 60 minutes at 70°F. Rinse and immerse in 5-10% ferric oxalate solution, adjusted to pH 6 to 6.5 by ammonia, for 20 min. at 122°F.

Electroformed Screen

U. S. Pat. 2,291,829. E. O. Norris, assignor to Edward O. Norris, Inc., August 4, 1942. A process for producing a matrix for electroforming screen.

Coloring Iron

U. S. Pat. 2,289,443. C. E. Mange, assignor to Jackes-Evans Mfg. Co., July 14, 1942. A method of coloring steel with a hard black corrosion and temperature resistant film which comprises applying a hydroxyl-containing solution comprising a lithium salt and the salt of an alkali metal other than lithium; any non-hydroxyl anions present being members of the class consisting of acetate, nitrate and nitrite; and heating the surface of the steel to approximately 800°F.

Also a solution containing lithium hydroxide, sodium nitrate, sodium acetate, water, isopropyl alcohol and a sulfonated ether.

Examples:	1.	2.	3.	4.	5.	6.	7.
Lithium hydroxide—grams	1.72	2.1	2.0	0.49	2.0	2.0	2.0
Sodium nitrate—grams	0.15	...	...	...	...	...	...
Sodium acetate—grams	0.12	0.32	...	...	...	...	...
Sodium nitrite—grams	0.12	...	...	...	...	...	...
Water—ml.	60	36	42.5	50	100	42.5	42.5
Isopropyl alcohol—ml.	40	64	57.5	...	...	57.5	57.5
Sulfonated ether (Triton 720)—ml.	0.2	0.21	0.25	...	...	0.25	0.25
Sodium hydroxide—grams	...	...	0.4	0.89	0.49	0.4	
Potassium hydroxide—grams	...	...	...	...	...	...	0.4

These solutions may be applied by brushing, dipping, spraying or roller coating. The articles are then heated at 800°F. until black. Lower temperatures may be used but longer heating periods are required.

Bright Nickel Bath

U. S. Pat. 2,290,342. R. Lind, W. J. Harshaw & K. E. Long, assignors to The Harshaw Chemical Co., July 21, 1942. A bright and ductile nickel bath consisting of nickel sulfate and nickel chloride to which has been added an azo compound containing the group Ar-N:N-Ar and another addition agent selected from the group consisting of naphthalene sulfonates, single ring aryl sulfonamides and single ring aryl sulfimides and mixtures thereof, the first addition agent being present in amounts from 1 to 100 mg./l. for brightening the deposit and the second in amounts upward from 0.2 g./l.

Examples of Azo Compounds: Chrysoidine, p-amino azo benzene, Brilliant Croceine 3BA, Pontamine Yellow SX, Pontachrome Blue R, and Direct Blue D3B.

Examples of Aromatic Sulfon Compounds: Alpha naphthalene monosulfonate, naphthalene di and trisulfonate, saccharin, benzene sulfonamide, ortho and para toluene sulfonamide and benzene sulfohydroxamic acid.

Example of Bath:

Nickel sulfate	240 g./l.
Nickel chloride	37.5 "
Boric acid	37.5 "
Sodium lauryl sulfate	0.25 "
Sulfonated naphthalene	20 cc./l.
Chrysoidine	10 mg./l.
pH	3.0
Temp.	50°C.
C.D.	40 amp./sq. ft.

Indium Bath

U. S. Pat. 2,287,948. C. F. Smart, assignor to General Motors Corp., June 30, 1942. A non-cyanide indium bath consisting essentially of one gallon of water of an indium compound containing from 1 to 6 oz. of indium, dextrose approximately one-half the indium content and at least 1 oz., and sodium hydroxide from about 6 to 12 oz. operated at about 70°-175°F., 10-150 amp./sq. ft. and about 3 to 10 volts.

Example:

Indium	4 oz.
Dextrose	3 "
Sodium hydroxide	8 "
Water	1 gal.

The solution precipitates indium hydroxide at boiling temperatures and this procedure can be used for recovering the indium from old solutions.

pH Testing

U. S. Pat. 2,288,180. F. C. Brengman & M. E. Parker, assignors to Beatrice Creamery Co., June 30, 1942. A portable pH testing apparatus of novel design consisting of two antimony electrodes connected to a microammeter, one of the electrodes being in contact with the solution and the other in contact with a standard pH buffer solution which is kept from mixing with the solution under test by a semi-permeable diaphragm.

Corrosion Prevention of Zinc, Cadmium

U. S. Pat. 2,288,007. J. C. Lum, assignor to Westinghouse Electric & Mfg. Co., June 30, 1942. A method of providing a stable protective coating on zinc or cadmium which comprises applying a solution containing a chromium compound and a mineral acid to the metal and thereafter applying a hot aqueous solution containing at least one solute selected from the group consisting of alkali hydroxides and chromate or dichromate salts to provide for a durable, heat stable protective coating.

Example:

Bath 1.	Chromic acid	50 g./l.
	Sulfuric acid	10 "

Immerse for 10 seconds and then stabilize in:

Bath 2.	Sodium dichromate	10%
	Sodium hydroxide	1%
	Water	89%

After a 30 second immersion at boiling, rinse in hot water and dry.

Silver Plating Steel Over A Phosphate Coating

By P. J. LoPRESTI

Rochester, N. Y.

IN plating steel directly with silver, a study was made to find a substitute strike for the commonly used nickel and copper strikes. It was found that a dip in a 10 to 25% phosphoric acid solution followed by a single strike in a solution of ¼ oz. per gallon of metallic silver with 10 oz. per gallon free cyanide solution and then plating in a standard silver cyanide solution, produced a deposit that was remarkably adherent.

Historical

Phosphate coatings have been used commercially on steel as a base for lacquers, enamels and as a final corrosion resistant coating.[1] Since no literature has been published on phosphate coatings under electroplated coatings it was decided to investigate this process to see if it produces greater adhesion and corrosion resistance. Salt spray tests for corrosion resistance, Erichsen tests for adhesion and photomicrographs of the deposit were taken.

Experimental

Method of Plating Samples

The tests were all carried on in comparison with the present method of plating steel. Samples were low carbon sheet steel, .060" x 2" x 1½".

Present Method	*Phosphate Method*
1. Degrease	1. Degrease
2. Electroclean	2. Electroclean
3. Rinse	3. Rinse
4. 10% hydrochloric acid dip	4. 25% phosphoric acid dip
5. Rinse	5. Rinse
6. Cyanide dip	6. Silver strike—½ oz. per gallon silver; 6-12 oz./-gal. sodium cyanide
7. Silver strike—¼ oz. per gallon of silver; 6 oz. per gallon free sodium cyanide	7. Silver plate—45 min. at 5 amp./ft.²
8. Silver strike of ½ oz. per gallon silver; 6 oz. per gallon free sodium cyanide	
9. Silver plate—45 min. at 5 amp./ft.² Operated at room temperature.	Operated at room temperature.

Silver solution used:

Metallic silver—	3 oz. per gallon
Free cyanide—	6 " "
Sodium carbonate—	6 " "

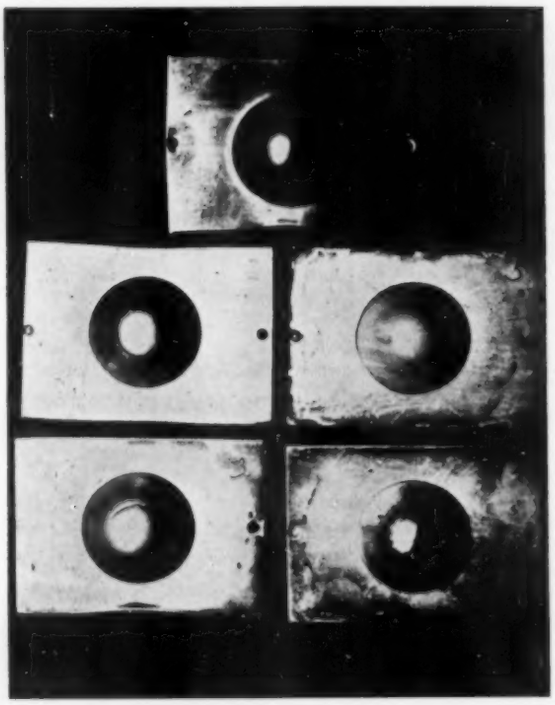
Salt Spray Test

Code of Sample Plates	*Condition*
A—Regular plate— 45 min. at 5 amp./ft.²	Good, slight rust
B—Regular plate— 45 min. at 5 amp./ft.² (annealed at 750°F. for 1 hr.)	Poor, rust over sample
C—Phosphate dip, single strike regular 45 min. at 5 amp./ft.²	Good, slight rust
D—Phosphate dip, single strike	Poor, rust over sample

Samples were kept in a 20% salt spray at 70° F. temperature for 24 hours.

The results of this test show that the phosphate coating does not improve the corrosion resistance of the deposit. Annealing also makes both the regular silver and that with the phosphate dip corrode much more. An explanation could be that annealing increases the size of the crystals and concentrates impurities in the grain boundaries. This

Philip J. LoPresti



Erichsen Cups of Test No. 1
Top sample—Steel S, unplated
No. 2 C—Phosphate treated
No. 3 A—Regular plate
No. 4 B—Regular plate (annealed)
No. 5 D—Phosphate treated (annealed)

condition will concentrate the attack of the salt spray much more than when the silver is left in the fine grain condition that exists with electroplated silver.

Erichsen Tests

Samples of as plated and annealed plates at 750° F. were placed in an Erichsen testing machine and pressure applied until the formed cup broke. The depth of the cup formed was about 7 mm. before a rupture occurred. The photograph shows the results of the test if examined closely. The annealed samples were tarnished but the adhesion was good on all samples.

Results of Erichsen Test No. 1

Code	*Condition*
No. 1 Steel S—No plate	
No. 2—A—Regular plate	Good adhesion
No. 3—B—Regular plate (annealed)	" "
No. 4—C—Phosphate dip	" "
No. 5—D—Phosphate dip (annealed)	" "

In this test all the samples showed good adhesion. Annealing did not improve the adhesion of the deposit. This test was carried on for sample plates annealed in a neutral atmosphere at 750° F. for one hour. The theory being that silver[2] has a relatively high permeability to oxygen at higher temperatures and it is believed that when silver plated objects are heated, oxygen diffuses through the silver to form an oxide on the base metal or creates a pressure sufficiently great to cause the silver to exfoliate. Naturally

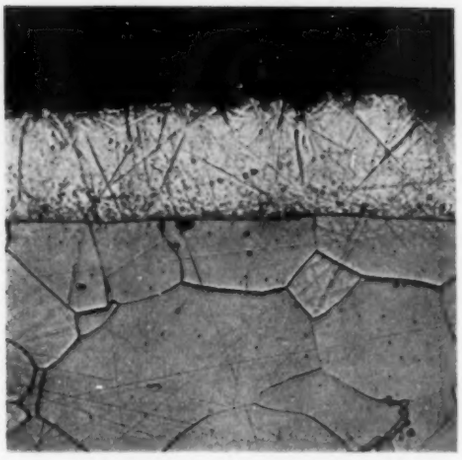


Fig. 1. Copper plated steel.

Fig. 2. Silver plated steel with no phosphate treatment.

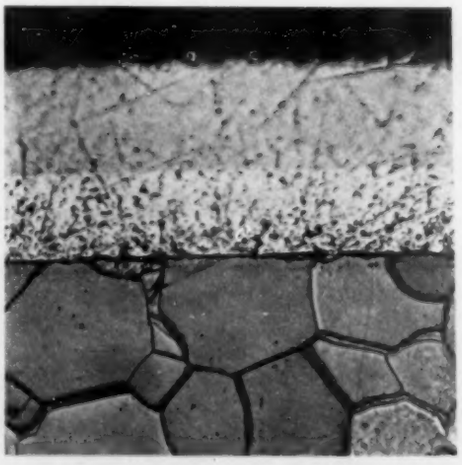


Fig. 3. Silver plated steel with no phosphate treatment (annealed).

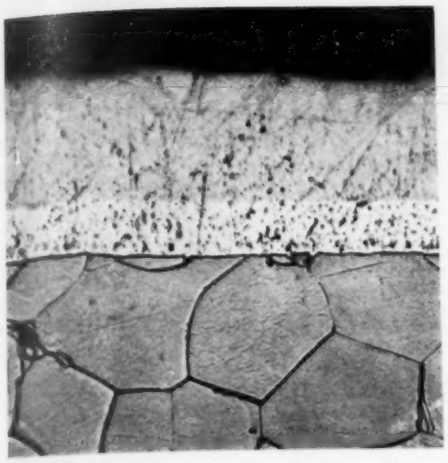


Fig. 4. Silver plated steel with phosphate treatment.

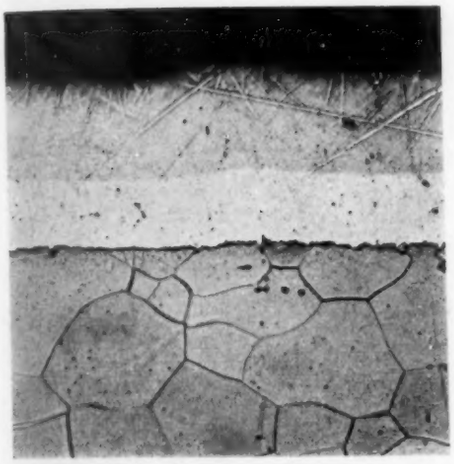


Fig. 5. Silver plated steel with phosphate treatment (annealed).

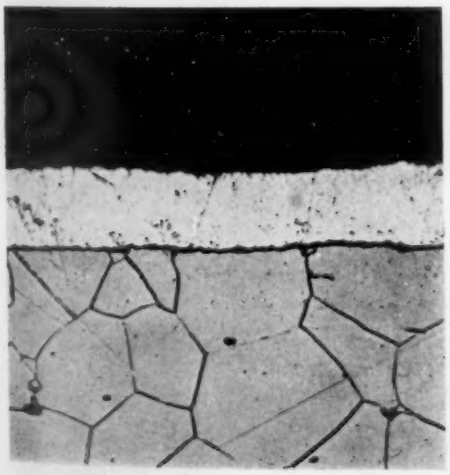


Fig. 6. Silver plated steel with no phosphate treatment (annealed in neutral atmosphere).

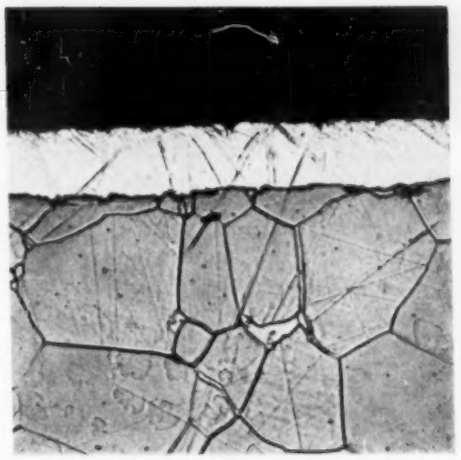


Fig. 7. Silver plated steel with phosphate treatment (annealed in neutral atmosphere).

the degree of exfoliation depends upon the length of time exposed to the high temperature and the thickness of silver coating.

These reactions should uphold the theory mentioned above and the oxygen formed in annealing should cause exfoliation on blistering.

Results of Erichsen Test No. 2

In this test samples were plated in the same manner as in Erichsen Test No. 1. The sample plates were annealed in a neutral nitrogen atmosphere at 750° F. for one hour. All samples were blistered around the formed cup. The results of this test show that annealing silver plate in a neutral atmosphere does not prevent exfoliation of the deposit and that possibly the nitrogen diffuses into silver plate and causes blistering in the same manner which oxygen produces as mentioned above.

Photomicrographs

Photomicrographs of all sample plates as described on the code sheet were taken. The photomicrographs were taken at 500 magnification. The sample plates were mounted in Bakelite, polished, etched with nital which brought out the grain structure of the steel base.

Figure No. 1. Unplated sheet steel (low carbon)—etched (500X). Etched in nital. Photomicrograph shows smooth line between base metal and copper plate. Copper plate covering is used to facilitate polishing of mounted specimen.

Figure No. 2. Regular silver plate 45 min. at 5 amp./ft.^{2} Etched in nital (500X). Photomicrograph shows very light etching of the base metal and no diffusion of the silver plate into the base metal.

Figure No. 3. Regular silver plate 45 min. at 5 amp./ft.^{2} (annealed at 750° F. for one hour). Etched in nital (500X). Photomicrograph shows slight etching of the base metal.

Figure No. 4. Regular silver plate 45 min. at 5 amp./ft.^{2} over a single strike with the phosphoric acid dip. Etched in nital (500X). The photomicrograph shows the deep etching of the base metal and phosphate covering which

follows closely the contour of the steel and penetrates into the grain boundaries. This etching could account for good adhesion of the silver plate to the base metal.

Figure No. 5. Regular silver plate 45 min. at 5 amp./ft.^{2} over a single strike with phosphoric acid dip (annealed at 750° F. for one hour). Etched in nital (500X). The photomicrograph shows the deep etching of the base metal.

Figure No. 6. Regular silver plate 45 min. at 5 amp./ft.^{2} (annealed at 750° F. for one hour in neutral atmosphere). Etched in nital (500X). The silver plate does not diffuse into the base metal but shows separation. This indicates lack of adhesion between base metal and silver plate.

Figure No. 7. Regular silver plate 45 min. at 5 amp./ft.^{2} over a single strike with phosphoric acid dip. (Annealed at 750° F. for one hour in neutral atmosphere). Etched in nital (500X). The photomicrograph shows a phosphate coating which is deposited thick over various sections of the base metal. The silver plate shows very little diffusion into the base metal.

Fink and DeMarchi[3] state that alloying between iron and silver takes place in electrodeposition of silver directly on iron. A sample plate was examined at a magnification of (2000X). No alloying between the silver and steel was observed. This finding is substantiated in the American Society for Metals Handbook, 1939 Edition, page 359, which states that iron and silver are mutually insoluble except for slight solubility of iron and silver at (1000° C.).

Conclusion

It was found that a thin deposit from a 25% phosphoric acid solution formed in about 30 seconds at room temperature will improve the adhesion of silver plate. Annealing in an ordinary atmosphere at 750° F. did not decrease the adhesion of the silver plate to the base metal when using the phosphoric acid dip or plating in the regular manner using two strikes. It was found that annealing in the neutral atmosphere reduced considerably the adhesion of the silver plate to the base metal.

Acknowledgment

Sincere appreciation is expressed for assistance given by Prof. W. J. Conley of the University of Rochester, Department of Metallurgy; to Mr. Keating of Eastman Kodak Company, Camera Works and to Mr. V. Patterson, Chief Metallurgist of the Bausch and Lomb Optical Company, Rochester, New York, who prepared the photomicrographs.

References

1. Parker Rust Proof Co., Detroit, Michigan.
2. *Metal Finishing*—July 1942, page 366.
3. Electrochemical Society Preprint 74-25

HARD CHROMIUM PLATING

By Austin Fletcher

The Brewer-Titchener Corporation, Binghamton, N. Y.

THE increasing use of hard chromium plating in the tool industry will bring to the plater problems not only of plating but of tool making, designing, grinding and heat treating. With these problems facing him, he will find that he will need help, and this can only be obtained from everyone in an organization who uses or makes the tools or dies to be chromium plated. Unless there is complete co-operation between every one, the plater had better not start hard chromium plating. When this co-operation is obtained, he should turn to the most important part of hard chromium plating—racking.

Racks

The racks should be made of copper. Without exception they must be able to carry more amperage than will be required for doing the job. This principle must be carried through the entire rack right down to the very end of each clamp. Spring clips, etc., do not work very well. The racks should be constructed with bolts, nuts and washers and with copper clamps the ends of which, when pulled up, will be tight against the spine of the rack.

The work is held between the spine and the clamp. This construction guarantees sufficient current to the piece to be plated, positive contact and even distribution of current. Whenever possible, the widest area of the piece to be plated should be attached to the spine of the rack, providing, of course, that chromium is not required to a given thickness down to the very end of the object which would be against the spine. If this is required, the object must be shimmed out from the spine and the spine should be stopped off from plating. All the high spots and ends must be protected from excessive current. Due to the many problems involved in protecting the right spot, this will have to be learned from experience.

Stopping off the rack and certain areas of the object from plating again is something which can only be learned by experience. Sheet steel and lead, steel and copper wire and stop-off lacquers, enamels and materials are required. Each works equally well when applied to the right place. Inside anodes are required for all inside plating. Steel usually works very well. This type of rack is usually built first to hold the object. When it is securely held in position, the inside anode is built on the rack, insulated, of course, and a connector put on for attaching to the anode rod. All inside plating should be done with the widest end of the cavity to the top, whenever possible.

Pre-Treatment

The regular cleaning and muriatic acid dip are sufficient before brushing with pumice stone. Then go into hot water until the object is heated through. Apply reverse current† in the chromium plating solution for from 1 to 3 minutes, and without removing the work, start to plate. Start with low amperage and continue up to 4 to 8 amp./in.^{2}. Rinse in hot water and bake at 300 to 500°F. for 1 to 5 hours.

Plating Solution

Chromic acid	53-57 oz./gal.
Chromic acid-sulfate ratio	73-74:1
Temperature	135-141°F.

The ideal thickness for best results on all types of cutting tools is 0.0002″ of chromium. Above that anything is liable to and does happen.

† U. S. Patent No. 1,645,927 of Metals Protection Corp., Indianapolis, Ind.—Ed.

THIS IS WASHINGTON—

By George W. Grupp

METAL FINISHING's Washington Correspondent

Order L-110 Revision Proposed Preparatory to a meeting of the Electroplating Industry Advisory Committee a revision is being made of Order L-110 to overcome some duplications of ratings. Another proposed change is that of easing the restrictions on small electroplating equipment items. No changes are contemplated for the larger items.

McCord Slated For Another Position W. W. McCord, who is well known to the electroplating industry, who came to the WPB as an industrial specialist in December, 1941, and who was promoted to Chief of the Electroplating Unit, is slated for some new position of importance in the Consumer Durable Goods Division of the WPB.

Advertising Exhibit Attracts Attention In the lobby of the Department of Commerce building in Washington, D. C., there is an excellent exhibition of industrial newspaper and magazine advertisements, posters and car cards of wartime advertising with such copy appeals as conservation of time and materials; explaining price control; improving labor relations; improving national health; increasing war production; preventing sabotage; promoting salvage campaigns; and selling bonds. The exhibit has attracted considerable attention.

Aluminum Plant Begins Operations The Olin Plant, the fifth aluminum reduction plant made possible by the Bonneville-Grand Coulee power system, recently began operations. With this new addition the northwest will soon be producing annually about $100,000,000 worth of aluminum.

American Platinum Works Seized On September 8, 1942, Alien Property Custodian Leo T. Crowley seized the property of the American Platinum Works of Newark, New Jersey and the property of the Resinous Products & Chemical Company Incorporated of Philadelphia, Pennsylvania.

Army Auditing System Simplified The auditing of Army cost-plus-a-fixed-fee supply contracts has been simplified when the contractor has a satisfactory system of cost analysis control. All documents and schedules are subject to review, but a detailed check on every item is only made on selected representative sections.

Army Insignia Sales Applications Supplementary Order L-131-a issued on August 28, 1942 restricts the sale of Army officers' military insignia to persons authorized by the Adjutant General's Office of the War Department. Applicants to handle such insignia must apply to the Adjutant General's Office, Washington, D. C.

Aromatic Petroleum Solvents Order Aromatic petroleum solvents used for protective coatings were placed under complete allocation control on October 1, 1942 by General Preference Order M-150 as Amended August 29, 1942. An exemption to this Order is a person who uses sixty gallons or less of aromatic petroleum solvents in one month.

Bauxite Blocked in Georgia The geologists and engineers of the Department of Interior's Bureau of Mines and the Geological Survey have blocked out more than 500,000 tons in new found deposits of bauxite in Smith and Macon counties in Georgia. More than 200,000 tons of these bauxite deposits contain better than 50% of alumina.

Bureau of Finance Abolished The Bureau of Finance of the War Production Board was abolished on September 15, 1942. "The Bureau of Finance," Mr. Lou Holland, head of the WPB Smaller War Plants Division, said, "was set up at a time when the numerous financing facilities we have today were not functioning as smoothly as they now are and banks were less inclined to make loans to smaller war contractors. The Bureau performed well a useful function in assisting contractors in overcoming these obstacles by showing those in need of money how to present their cases to the banks and to Government financing agencies. We now have the Smaller War Plants Corporation, which has money of its own, and loans can be made directly to any borrower whose application merits acceptance."

Caustic Soda Restrictions Eased Exemption No. 2 to Priorities Regulations No. 11 eases the purchases of certain materials such as refractory brick, borax, caustic soda and soda ash for firms operating under the Production Requirements Plan.

Chemical Price Reductions A considerable reduction in the price of certain chemicals was ordered by Price Administrator Leon Henderson through the issuance of new regulations and effective September 3, 1942 and covered by Maximum Price Regulation No 37 (Butyl Alcohol and Esters thereof) and Maximum Price Regulation No. 36 (Acetone). The maximum price for fermentation acetone is reduced from 15.8 to 8.5 cents per pound; and the maximum price for normal fermentation butyl alcohol is reduced from 15.8 to 12.5 cents a pound. Regulation No. 37 orders an increase from 12.5 to 13.5 cents a pound for normal fermentation butyl acetate.

Citizens Handbook Issued Since thousands of letters were received in Washington from citizens from all parts of the United States asking what they could do to help win the war, the Office of Civilian Defense has just released for free distribution a 50 page illustrated booklet on "What I Can Do: The Citizen's Handbook for War," which makes appropriate war work suggestions for people engaged in 73 occupations; and for further reading it contains a bibliography of over 100 booklets which may be obtained free.

Citizenship of Workers A prospective worker for a war contractor, according to an Army and Navy Memorandum, can establish

his United States citizenship one of three ways. 1. He should present an Army, Coast Guard, Marine Corps, or Navy discharge which shows that he was not an alien at the time of its issuance. 2. He should execute "a prescribed Declaration of Citizenship form in the presence of two witnesses, one of whom must be an Army or Navy District Procurement, Factory or Plant Protection representative, or an officer of the United States Army, Navy or Marine Corps, or a member of the Auxiliary Military Police on duty at the plant." 3. He should present a birth certificate or other satisfactory evidence of American birth.

Cobalt Usage Limited — The use of cobalt for ground coat frit has been limited, in any calendar quarter, to 35 per cent of the amount used in the first six months of 1941, according to the August 21, 1942 Amendment No. 2 to Cobalt Conservation Order M-39-b.

Contract Distribution Branch Abolished — The WPB Contract Distribution Branch was abolished on September 15, 1942, and the Smaller War Plants Division of the WPB Smaller War Plants Corporation took over its functions. The new set-up, according to Lou Holland, deputy Chairman of the SWPC, will accomplish a wider distribution of war work among small plants.

Contract Production Control Experiment — Three firms with Navy contracts for radios are the guinea pigs for the Contract Production Control plan which is being tried out by the WPB. If it is a success it will be universally adopted by the WPB for controlling the flow of materials. Under this plan the prime contractor obtains from his subcontractors on Form CPC-2 all information which indicates his materials requirements and shipping schedules to the prime contractor. These data are then recapitulated on Form CPC-1 by the prime contractor together with a statement of his own materials needs and production schedule. Preference ratings are then assigned by the WPB to all approved deliveries of materials.

Copper Allocation — The War Production Board revealed that about 66 per cent of 14,000 firms throughout the United States who reported having 111,000,000 pounds of idle and excess inventories of copper and copper base alloy offered to sell their copper at Government prices. Out of this total, 29,700,000 pounds have been allocated. About 2,400,000 pounds were allocated for stockpiling for future needs; 9,300,000 pounds were allocated for use in existing form under Priorities Regulation No. 13; 6,300,000 pounds were allocated as scrap; and 11,700,000 pounds were allocated to brass mills and ingot makers for remelting.

Copper Chemicals Under Control — General Preference Order M-227, dated September 8, 1942, placed under complete allocation control on October 1, 1942 such copper chemicals as copper sulphate, copper carbonate, copper chloride, copper oxide, copper nitrate and copper cyanide. Small deliveries, 450 pounds of copper sulphate or 25 pounds of the other chemicals per calendar month, may be made by certification from the purchaser to his supplier. Forms PD-600 and PD-601 must be used in seeking allocation.

Copper Inventories Made Available — The Copper Branch of the WPB on August 26, 1942 made it easy for users of copper and copper base alloy products who hold the required preference ratings to buy these goods from owners of frozen, excess or idle inventories. Detailed inventories of millions of pounds of copper products in the form of rod, shapes, sheet, tubing and wire which can be sold to war production plants may be seen at the offices of the Copper Recovery Section of the WPB Copper Branch located at 200 Madison Avenue, New York City. In making application for any of this available material, form PD-595 must be used.

Copper Restrictions Increased — The August 31, 1942 Amendment No. 6 to Copper Conservation Order M-9-c as Amended May 7, 1942 provides, as a result of an agreement between Army, Navy and Maritime Commission, that the use of copper in the manufacture of articles is prohibited, even for the armed services, if the articles are not included in the "Military Exemption List" of Conservation Order M-9-c.

Copper Scrap Price Regulation — The Office of Price Administration, in Amendment No. 2 to the Revised Copper Price Schedule No. 20 as amended, ruled on August 29, 1942 that brass and bronze ingot makers with a monthly output of less than 100 tons and who lack briquetting facilities may apply to the OPA for permission "to pay the applicable premiums for briquetted copper scrap."

Corundum Order Amended — The Corundum General Preference Order M-89 as amended September 16, 1942 clarifies certain points in the original Order and requires the usage of two new forms PD-294 and PD-294A in addition to the regular form 293.

Cyanamid Allocation Regulation — On September 1, 1942 cyanamid derivatives such as cyanides, dicyandianide and guanidine which are used in non-ferrous mining and the manufacture of plastics were placed under complete allocations control by Amendment No. 1 to Cyanamid General Preference Order M-165.

Dispossession Regulation — The Construction Bureau of the WPB announced on September 16, 1942 a method of expediting emergency applications to replace or rebuild property which owners were dispossessed of because of acquisition for use by Government war agencies. The applicant should give to the WPB field offices for transmission to the Construction Bureau, form PD-200 completely filled out and such other information as the name and present location of the applicant, name of Government agency submitting confirming letter giving reason for dispossession, number and sizes and values of structures dispossessed of, and a description of the proposed new building.

Ferro-Alloys Branch Created — The WPB combined the Nickel, Tungsten, and Manganese-Chrome Branches into the Ferro-Alloys Branch on September 9, 1942. Miles K. Smith, formerly head of the Tungsten Branch, is Chief of the new branch; Andrew Leith, formerly head of the Manganese-Chrome Branch, is Deputy Chief of the new branch. Harry A. Rapelye, formerly head of the Nickel Branch, has been made Special Assistant to A. I. Henderson, Deputy Director General for Operations.

Frozen Materials Prices — Idle or frozen materials sold under WPB Priorities Regulation No. 13 may now be disposed of at f.o.b. present location prices according to Amendment No. 1, dated September 16, 1942, to Maximum Price Regulation No. 204.

Fuse Order Saves Copper — Limitation Order L-161, dated August 25, 1942, prohibits the use of "any copper or copper base alloy except as a conductor of electric current" in the manufacture of electric fuses. This Order aims to save annually 2,400,000 pounds of copper.

Galvanized Iron History

Recently a reader of the Washington Evening Star asked the columnist Haskin: "By whom was galvanized iron first made?" This is the reply as published in the Star: "It is recorded that as early as 1743 a Frenchman Malouin knew of a plan for coating iron with zinc. Bishop Watson in his Chemical Essays, issued in 1786, stated that a method essentially the same as that now in use was then practiced at Rouen for coating hammered iron saucepans with zinc. The first English patent for galvanizing iron was granted to H. W. Craufurd in 1837, and another for the zincing of iron which had been previously tinned was taken out by E. Morewood in 1821."

Industrial Construction Required Forms

The industrial construction limit remains at $5,000 in Construction Conservation Order L-41 as amended September 2, 1942. Drastic cuts were made as it concerns different types of commercial structures. And on September 15, 1942, the WPB granted permission to apply for blanket authorization for industrial plant construction work over a period of not to exceed six months on form PD-1A for a single item and form PD-200 for several different items.

Industrial Equipment Ratings Changed

The August 27, 1942 Amendment No. 1 to General Industrial Equipment Limitation Order L-123 provides that the preference rating required to get certain types of general industrial equipment such as elevators, fans, pumps and other equipment designed for industrial use has been raised from A-9 or higher to A-1-c or higher except in the case of the Army, Navy and other exempted Government agencies.

Marine Insurance Rates Changed

Effective September 1, 1942 the War Shipping Administration has withdrawn nominal war risk insurance rates covering the importation of such commodities as nickel and alloys, manganese ores, industrial chemicals, chrome ore or chromite, and jewelry and metal articles. The new rates are those prevailing in the month of July and published in WSA bulletins C-5 and C-6.

Metal Doors Banned

Limitation Order L-142, dated September 16, 1942, prohibited the production of metal doors, metal door frames and metal shutters for both military and civilian uses except fire doors of certain maximum specifications and airplane hangar doors.

Metallic Pail Production Curbed

The manufacturers of metallic packing and shipping pails and tubs were restricted in their production by Amendment No. 7 to Limitation Order L-30 dated August 24, 1942. Such containers may now be produced only if they are to be used to ship goods to the armed forces.

Naphthenates Under Stricter Control

Naphthenic Acid and Naphthenates were placed under stricter control by General Preference Order M-142 as Amended September 5, 1942 and effective October 1, 1942. Forms PD-438 and PD-439 were discontinued by the Order. In the future forms PD-600 and PD-601 must be used.

Non-Ferrous Producers' Tax Exemption

The Senate Finance Committee in giving consideration to the new tax bill voted to encourage the mining of strategic minerals by exempting from excess profits tax the profits derived from the mining of antimony, chromite, manganese, platinum, quicksilver, tin, tungsten and vanadium.

Non-Ferrous Sound Films Available

To reinforce the efficiency of manpower in factories, the Interior Department's Bureau of Mines' free educational motion pictures are being shown in increasing numbers. It has silent films on "The Story of Asbestos"; "Manufactured Abrasives"; "The Story of a Storage Battery"; "Nickel"; "Aluminum: Mine to Metal"; "Aluminum Fabricating Processes"; "Copper Mining in Arizona"; "Copper Leaching and Concentration"; "Copper Smelting"; "Copper Refining"; "Fabricating of Copper"; and many others. Some of the available sound films are on such subjects as "Nickel Mining"; "Nickel Milling and Smelting"; "Nickel Refining"; "Lead Mining in Southeast Missouri"; "Lead Milling, Smelting & Refining"; and "Manufactured Abrasives". These and other silent and sound films may be loaned for the mere cost of transportation since no rental charge is made. All applications should be made to the Bureau of Mines Experiment Station, 4800 Forbes Street, Pittsburgh, Pennsylvania.

Non-Ferrous Workers Frozen

Since he is without legislation to enforce his ruling to prevent labor pirating from the non-ferrous metal industries, on September 8, 1942 Chairman Paul V. McNutt directed all departments and agencies of the United States Government Employment Office to take every possible measure to freeze those workers in their positions because of the manpower losses suffered by these essential industries.

Non-War Industries Pooling Proposed

A plan for the pooling of non-war industries is being considered by the newly created WPB Committee on Concentration of Production which consists of Wendell Lund, Director of the WPB Labor Division; Lou Holland, Deputy Chairman of the WPB Smaller War Plants Corporation; and Joseph L. Weiner, Deputy Director of the Office of Civilian Supply who is the Committee's chairman.

Personnel Efficiency Principles

Some principles to increase the efficiency of 700,000 civilian employees of the Service of Supply of the War Department were formulated by James P. Mitchell, Director of Service of Supply Civilian Personnel, which might be helpful to readers of *Metal Finishing*. They are: "1. Make sure that each employee knows definitely what his job assignment is and how to do it. 2. Encourage employees to express their ideas and views on matters affecting their jobs and interests. 3. Give consideration to these ideas and views before making decisions. 4. Insure that no one is ignored on matters concerning which he has a right to be consulted, and insofar as practicable, make sure that no one is ignored on matters concerning which he thinks he has such a right. 5. Fully and freely explain all matters affecting employee relations. 6. Make sure that employees' responsibilities are always coupled with corresponding authority and that no change is made in the scope of these responsibilities without a definite understanding to that effect on the part of all concerned. 7. Give directions only to immediate subordinates and never over the head of any lower-ranking supervisor. 8. Make any necessary criticisms to an employee privately and in such manner as to improve the individual's performance or conduct and to preserve his self respect."

Phosphorus Under Allocation Control

General Preference Order M-230, dated September 9, 1942, placed phosphorus under complete allocation control beginning October 1, 1942. Applicants for allocation must apply on form PD-600; and suppliers must make monthly reports on form PD-601. Anyone seeking 1000 pounds or less of phosphorus in any calendar month may obtain delivery by certificate to his supplier and need not file form PD-600.

Research Laboratories Chemical Ratings — Amendment No. 2, dated September 7, 1942, to Research Laboratories Supplies and Equipment Preference Order P-43 provides that "preference rating A-1-a is hereby assigned to deliveries of reagent chemicals which will be used for research or educational purposes."

Service Trades Manual Issued — The Office of Price Administration has issued for free distribution "Manual No. 2 on Maximum Price Regulation No. 165" as it applies to service trades. It treats on the methods of determining maximum service prices; allowances and discounts; the treatment sales taxes; and it explains many other subjects.

Silicate of Soda Supply — Amendment No. 6 to General Inventory Order M-161, dated August 26, 1942, permits users of silicate of soda to build up inventories of this material without restrictions because of the relatively plentiful supply of commodity on the market.

Silver Disposal Proposed — Senator Theodore F. Green of Rhode Island introduced on September 14, 1942 a bill (S.2768) which proposes to authorize the President, "through the Secretary of the Treasury, to sell, lease, or otherwise dispose of—any silver held or owned by the United States" for war effort purposes.

Silver Exempted Uses — Amendment No. 1 to Conservation Order M-199, dated September 1, 1942, provides that the small amount of silver used in manufacturing karat gold is exempt from the restrictions of the original order. The buffing, polishing and sand-bobbing of an assembled silver article is not restricted by this Order.

Silver "Into Process" Interpretation — Interpretation No. 1 to Conservation Order M-199, dated September 1, 1942, reveals that restrictions placed on silver "into process" applies only to the first processing of silver. And the original Order "is not intended to restrict a manufacturer's use of scrap resulting from his own processing of silver for a restricted use."

Silver Loaned To Industry — A. I. Henderson, Deputy Director General for Operations announced on September 16, 1942 that about 1,350 000,000 ounces of "free silver", (silver held by the Treasury in excess of currency requirements), "has been loaned to war industry or commitments have been made for its use." This silver has not, and will not, be released to non-essential civilian industries such as jewelry and silverware manufacturing. This silver is to be used for brazing alloys, for a substitute of tin in solder, and for other purposes.

Silver Prices — The Office of Price Administration in the issuance on August 29, 1942 of Amendment No. 12 to Supplementary Regulation No. 14 of General Maximum Price Regulation reveals that sellers of semi-fabricated silver articles such as silver alloys, grain, shot, powder, wire, sheet, blanks, circles, solders, brazing alloys, sintered products, silver-clad metals, silver-inlays and bar silver, are permitted to pass on to the customer increased costs resulting from the use of newly mined domestic silver at 71.111 cents per fine ounce for standard commercial bars in place of imported silver at 35⅛ cents per fine ounce. The resale of imported silver must not exceed 35⅛ cents per fine ounce.

Small Business Hearings — Hearings are to be held by the Senate on pending small business bills and on proposed legislation which aims to aid concerns hit hard by the war program.

Steel Drum Coating Restrictions Eased — Conservation Order M-158 as Amended September 9, 1942 removed the restrictions on the use of color as exterior coatings for steel drums of over two gallons capacity. "Wash up salvage" coatings, the result of cleaning operations, may now be used without restrictions.

Steel Drum Usage — Limitation Order L-197, dated September 14, 1942, provides that after November 14, 1942 new and old steel shipping drums cannot be used to pack such commodities as alcohol, aluminum sulphate, ammonium chloride, solid arsenic acid, calcium chloride, dry cleaning compounds, copper oxide, copper sulphate (basic and monohydrated), lanolin and wool grease, magnesium oxide, metal degreasing alkalies, paints (dry casein, dry powder and paste), potassium chlorate, resins (solid, rough crushed and broken synthetic), shellac, soda ash, sodium chloride, and others. And immediately effective the Order bans the use of such drums for packing of such commodities as dry lead oxide, inorganic salts, paints (oil and oleoresinous types), metallic soaps, and varnish and varnish stains, except liquid water soluble phenolic resins.

Substitutes Fostered by Army — The Army expects to save in excess of 62,000,000 pounds of tin and aluminum during 1942 and 1943 because of the conservation efforts of the Ordnance Department. Plastics, silver and steel are being used as substitutes for tin; chromium steel liners are being used instead of tinned copper ones in smokeless powder boxes; plastics are being used as substitutes for aluminum in trench mortar fuses; and tests are being made to find a substitute for babbitt.

Tin Can Salvage Campaign — When the flow of cans to present detinning plants reach their capacity levels it is expected that old tin cans from United States kitchens will yield over 3,000 tons of pure tin. This the War Production Board believes will become one of the important sources of tin. And it has been announced that the domestic wartime demand for tin for tin cans, in excess of 21,000 long tons, will be cut in half in 1943 by a program now under way to use electrolytic tin plate and bonderized black plate instead of hot-dipped tin plate.

"Tinless Tin Cans" Hearings — Senator Guy M. Gillette of Iowa, a member of a Senate Agriculture Subcommittee, plans to call hearings to investigate the possibilities of using "tinless tin cans" for packing foodstuffs. Among those to be called will be Raymond S. MacMillan, President, MacMillan Petroleum Corporation, Los Angeles, California; and Albert A. Robbins, consulting chemist, the patentee of an all-fiber, plastic lined container now being used to distribute oil.

Tinned Scrap Regulation — Lead and Tin Scrap Supplementary Order 72-a and Supplementary Order M-24-a issued on September 9, 1942 provide for complete control over tinned and detinned scrap. The orders provide that tinplate clippings must only be sold to a broker, dealer or to a detinning plant, and no tinned scrap can be delivered or accepted by a producer of iron and steel.

WDC Does Big Business — About 3,500,000 enemy property damage insurance policies totalling $75,000,000,000 in coverage with premiums in excess of $100,000,000 have been written by the War Damage Corporation, a subsidiary of the Reconstruction Finance Corporation, since it began operations on July 1, 1942. The individual policies range in amounts from a few hundred dollars to $1,250,000,000 each.

PLATING AND FINISHING
POLISHING — BUFFING
CLEANING — PICKLING
HOT DIP FINISHES

SHOP PROBLEMS

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. The questions this month are answered by G. B. Hogaboom, Jr., Nathaniel Hall and Dr. Walter R. Meyer. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and kept confidential, if desired.

Dross in Hot-Tinning

Q. We are hot-tinning mild steel articles by the usual method, and have recently run into trouble. The tin becomes thick and pasty at the surface and the articles come out very rough. The thick metal can be skimmed off, but it forms again after comparatively few articles have been dipped.

A. The trouble arises from the formation of the compound $FeSn_2$. This compound is not formed to any extent by direct interaction between tin and the iron pot, but is produced by reactions of the flux during the process. Iron chloride is produced, and this salt reacts with tin to form the tin-iron compound.

The production of excessive amounts of this compound probably means that iron chloride is being introduced into the tinning bath. The flux solution may have been kept in an iron tank, or it may have become too acid due to carry over of pickling solution, in which case it would produce iron salts on the surface of the article before immersion in the tin.

If such possible sources of excessive iron contamination are eliminated the trouble should disappear. We would emphasize that tin in the form of dross and scruff is wasted. The present tin shortage requires the exercise of every possible measure of control to use economically the restricted supply of tin available.

De-Tinning Tinplate

Q. (From an overseas correspondent). At present it is impossible for us to ship tinplate scrap to the United Kingdom and we have now a large accumulation. What process of de-tinning is recommended?

A. Three processes are in commercial use. They are well described in *Tin* by C. L. Mantell (The Chemical Catalog Co., Inc., N. Y., U. S. A.).

The first uses chlorine gas; the scrap must be clean and dry, and although de-tinning is efficient it involves chemical engineering problems of the first order. The tin is recovered as stannic chloride.

The second is direct solution in caustic soda plus sodium nitrate. The process is carried out in autoclaves at about 15 lbs. gauge pressure. The tin is recovered in the form of sodium and calcium compounds.

The third is the method most widely practiced in Britain. It is a de-plating process, using weak caustic soda (1½% to 5%) at 40° to 60° C. The process takes 3-5 hours with 1½ volts. The tin is plated on to cathodes and is recovered largely as metallic tin and partly in a powdered form easily refined to a usable metallic form.

The chemical control of the process is simple, but the mechanical handling of the bulky scrap and its subsequent baling have to be provided for. If used cans are to be dealt with, handling becomes more troublesome and some preliminary cleansing is called for.

The success of the process is largely bound up with the ease with which the scrap can be procured and the readiness of the market for the tin and for the de-tinned scrap which, if the remaining tin content is under 0.1 per cent, is suitable for steel manufacture.

—From "Tin and Its Uses", July, 1942 pub. by Tin Research Institute, Battelle Memorial Institute, Columbus, Ohio.

Plating Steel Knives

Colrain, Mass.

"Dear Sir:

I am interested in silver plating steel knives. Sometime ago, I believe an article was printed in METAL FINISHING on this subject.

Steel knives in the future will have a mirror finish before being silver plated, and I am interested to learn if the knives will have to be put through a silver strike before placing in silver plating solution.

Any information you are willing to give me will be appreciated.

Yours very truly,
H. C."

Answer:

After proper cleaning, steel knives are best silver plated by going through first a steel strike, then a regular silver strike, and then silver plate.

First or steel strike:

Silver cyanide	0.2 oz.
Copper cyanide	1.5 "
Sodium cyanide	10.0 "
Sodium carbonate	2.0 "
Water to make	1 gal.

Use 6 volts, steel or carbon anodes, with a small amount of copper anode surface. Silver is added as the cyanide, as required by analysis, or enough to keep the deposit pink. After 15—30 sec. in this strike, transfer directly to:

Regular strike:

Silver cyanide	0.5 oz.
Sodium cyanide	9.0 "
Sodium carbonate	2.0 "
Water to make	1 gal.

Use 6 volts, steel or carbon anodes, plus small silver anode surface. Time 15—30 sec.

Silver plate:

Silver cyanide	3.5 oz.
Sodium cyanide	5.0 "
Sodium carbonate	5.0 "
Water to make	1 gal.

—G.B.H., Jr.

Paper on Spotting Out

Eau Claire, Wis.

"Gentlemen:

Will you please send us a copy of your bulletin on 'Spotting Out of Brass'.

N. P. Cooker Co."

METAL FINISHING does not publish a bulletin on spotting out.

However, an investigation on the subject at the Bureau of Standards by W. P. Barrows, was reported in the Bureau of Standards Research Paper No. 72, which appeared in the Journal of Research of the National Bureau of Standards, Volume 2, p. 1085, 1929. This paper discusses both types of spotting phenomena, one being the so-called copper sulphide type usually experienced on sulphur oxidized copper or silver, and the other, the so-called spotting out phenomenon which is attributed to a slow creep of alkali trapped in the pores of electroplated brass or copper. Both types of spotting can be markedly retarded by the use of proper clear lacquers or enamels, and frequently, lacquers with good sulphur spotting resistance are relatively poor against alkali spotting, and vice versa.

The research paper referred to gives suggested remedies.

Zinc Coating of Steel Wire

Long Island City, N. Y.

Dear Sir:

We should like to obtain some information as to the relative value of zinc plating and hot galvanizing for the protection of steel wire to be used in water.

A. L.

Answer:

I believe the most helpful statement to you in selection of a zinc coating is one to the effect that the corrosion protection afforded by zinc is directly proportional to the weight and thickness of the coating

regardless of whether the coating is produced by hot galvanizing or by electrogalvanizing. Incidentally, the terms "electrogalvanizing" and "zinc plating" are synonymous.

Commercial hot galvanized coatings range in thickness from 0.0005" to 0.001". Therefore, to get comparable protection by electroplating, I would suggest specifying thickness of 0.001" of zinc. I do not believe that hot galvanizing would be practical in view of the increased stiffness imparted to the wire by the hot galvanized coatings. This is due to the fact that in most cases, the coating is at least 50 per cent iron-zinc alloy whereas with electroplating, essentially no alloying occurs and the wire would be more ductile.

After plating, the zinc surface should be given protection by the use of either a phosphate coating, or a chromate coating produced in chromic acid with a small amount of sulfuric acid. Further details on this last-named process can be obtained from the New Jersey Zinc Company, 160 Front Street, New York City. The phosphate coating, being somewhat adsorptive, can be treated with special oils and waxes to give still further protection. You will thus have a combination oil and phosphate film protecting the zinc, and the zinc in turn protecting the steel.

—W. R. M.

Throwing Power of Alkaline Tin Solutions

Question: We are having difficulty depositing tin inside of stamped steel army mess kits. Specifications call for 0.0005-0.0007" of tin both inside and outside. We can get the required thickness outside but a deposit of only 0.0003" inside. We have tried regulating current density, temperature, anode area and voltage without success. The solution is the standard sodium stannate bath with a stannate concentration of approximately 17 oz./gal. The kits are plated on a semi-automatic conveyor. Have you any suggestions to offer regarding this problem?

Answer: The writer doubts whether variations in bath composition or temperature changes would solve your problem in view of the fact that the stannate bath has excellent throwing power and your problem should be one to equalize as nearly as possible the current distribution on the object being plated. Inasmuch as you are plating on a semi-automatic conveyor, the use of auxiliary anodes is precluded because of the expense of making connections to the auxiliary anode bar. However, we believe that the use of a bipolar electrode would help materially in solving your problem. This would involve some experimentation as to size of electrode and position of it. The method consists of fastening a piece of metal insoluble in the solution, in this case —steel, to the plating rack but insulated therefrom. It should be arranged so that it comes in between the recessed portion of the kit and the anode. Further details will not be given here inasmuch as the matter is discussed at some length in an article entitled "Useful Applications of Bipolarity in Practical Plating", by Frank K. Savage which appears elsewhere in this issue.

—W. R. M.

Etching of Steel

Question: I have been trying for some time to find a solution to etch steel. If you have any formulae to do this, will you forward them to me?

Answer: Solutions used for non-electrolytic etching of steel are usually those in which no evolution of gas occurs, such as hydrogen which would be obtained if hydrochloric acid or sulfuric acid were used. We suggest trying solutions of either ferric chloride or ferric sulfate. An excellent method for deep etching of steel is one employing sodium chloride, or ordinary table salt. Concentrations of the order of 10 oz./gal. are used but the concentration is not critical. The more dilute solutions appear to give a finer surface than the concentrated ones. The steel is made the anode with a potential of 5 to 6 volts across the electrodes. Current densities of from 1-2 amp./sq. in. are used. Agitation by means of compressed air or by paddles is recommended. The operation is conducted at room temperature and approximately 0.0005" are etched per minute. Copper and brass can also be etched very satisfactorily in the sodium chloride solution and a somewhat higher voltage, namely 8-10 volts is recommended.—W. R. M.

Effect of Temperature and pH on Hardness of Nickel

Question: From a survey of the literature and from opinions expressed by various practical platers, there appears to be a wide discrepancy in the knowledge of the effects of temperature and pH on the hardness of nickel deposits. Will you kindly tell us whether pH affects the hardness of nickel and also whether temperature is a factor.

Answer: Some observers believe that hydrogen is a factor in contributing to the hardness of the nickel but it is the writer's opinion that if hydrogen has any effect, it is indirect rather than direct. For example, it has been shown that hydrogen has practically no effect upon chromium plate.

The hardness of most electrodeposits is due to the combination of small grain size and possibly a state of stress, in some cases induced by the dispersion of other substances in the nickel lattice in a manner of the dispersion of solute atoms in so-called age-hardening alloys. In most cases, the hardness of electroplated coatings decreases with an increase in temperature and such is the case for nickel. For example, in one series of measurements, it was found that the hardness of nickel was 350 on the Vicker's scale, at a pH of 5.4 and a temperature of 140°; whereas it was 425 under the same conditions except for the temperature being 110°F.

Contrary to the belief of many, the hardness of nickel deposits drops with a decrease in pH at least within the pH range of 5.0 to 6.0. Hardness increases almost linearly with current density and for example in one case, the hardness was 350 (Vickers) at 10 amp./sq. ft., 400 at 40 amp./sq. ft. and almost 500 at 100 amp./sq. ft.

The composition of the plating bath also affects the hardness of the nickel but the factors are too complicated to discuss here.

—W. R. M.

Cathode Efficiency of Nickel Plating Solutions

Question: Will you kindly tell us what the cathode efficiency of the nickel plating bath is and whether this efficiency varies to any extent with current density, temperature and pH.

Answer: The cathode efficiency of most nickel plating solutions ranges above 95 per cent in the pH range from 3 to 5. For a Watts-type nickel plating solution composed of single nickel salts, nickel chloride and boric acid, it has been found that the cathode current efficiency varies only slightly in the temperature range from 75 to 160°F. and at 50 amp./sq. ft. with a pH of 5, the cathode efficiency ranges between 98 and 99.4 per cent.

As the pH falls, the cathode current efficiency slowly decreases until a pH of 3 is reached. Below 3, the efficiency may drop off from 10 to 50%, the drop being greater at the lower current densities.

Current density has almost no effect on efficiency between the ranges of 2 and 50 amp./sq. ft. It may thus be seen that nickel plating solutions operate at high efficiency under wide conditions with the exception of extremely low pH's.—W. R. M.

Who Knows the Answer?

Several inquiries have been made during the past month regarding processes with which we are not familiar. If anyone has information on them, the sending of it to the editor will be greatly appreciated.

These problems are as follows:

1. What is "Oxo-Seal"?

2. Does anyone know of a method for depositing coherent coatings of zirconium?

3. What is "midnight black"? One of our subscribers wrote us asking for a formula for "midnight black". We strongly suspect that he was kidding us but if this is the name of some proprietary or practical coloring process, will anyone who knows about it, write us?

Silvering Apparatus

U. S. Pat. 2,291,267. H. L. Weiner, July 28, 1942. An apparatus for producing silver films by chemical precipitation including containers for the different chemical solutions, controls for the rate of delivery, a mixing chamber and a means for applying the silvering mixture to the article to be coated.

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

Recovery of Copper

A new method for recovering copper by deplating it from iron and steel scrap was announced by the Electroplating Division of E. I. du Pont de Nemours & Company, Wilmington, Del.

Virtually 100 per cent of the copper, a vital war material, is recovered in a form satisfactory for direct use in electroplating important metal parts for military equipment, the company said. Large quantities of strip steel and iron may be made available for reuse.

Formerly, removal of copper plate was costly and most of the copper was wasted. Complete deplating under the new method is carried out rapidly under controlled operating conditions. Deplating takes place without attack of the base metal, in sharp contrast to usual stripping methods.

Many war products are fabricated from copper-coated steel strip. Resulting scrap metal is useless until the copper has been removed.

New Deodorant

Oakite Products, Inc., 18 Thames Street, New York, have just released a new material —Oakite Deodorant No. 1—developed to effect plant sanitation without the installation of additional facilities. Because so many iron and steel mills, foundries and metal working plants are faced with the problem of how to meet the sanitary requirements of a doubled and sometimes trebled labor force, this development should be interesting.

The material has a three-fold function. In addition to ordinary deodorizing properties, it offers detergent and disinfecting action.

Solutions of Oakite Deodorant No. 1 are easily prepared by mixing a small amount with cold water from the tap. Depending on the requirements of individual cases, the solution is applied with mop, brush, cloth or sponge.

Oakite Deodorant No. 1 is packed in 375 lb. and 125 lb. drums; also in 45 lb. pails.

New Grades of Potassium Silicate

Two new grades of potassium silicate have been announced by the Philadelphia Quartz Company, Philadelphia, Pa. Called "Kasil No. 2" and "Kasil No. 6", they are specially concentrated solutions, developed primarily for the manufacture of welding rods. One of the most important processes in the welding rod industry is the extrusion method of production which employs potassium silicate of correctly controlled viscosity.

Kasil No. 2 is a 32° Baume product with the molecular ratio of 1:3.92 and Kasil No. 6 is 40.5° Baume, with a molecular ratio 1:3.29. Both grades are offered at present in steel returnable drums as well as in single trip packages.

Other uses for the potassium silicate include carbon electrodes, paints and applications where non-blooming films are desired.

Safety Drum Opener

Industrial Products Company, 2820 N. Fourth Street, Philadelphia, Pa., have developed an item which is being marketed under the trade name "Ipco Safety Drum Opener."

This opener is designed to save time and to reduce the hazards in opening light and medium weight drums. It cuts smoothly, quickly and evenly, and folds in the cut edge close to the side.

The operation of the tool is simple, being made by a series of downward strokes similar to the can opener principle. When head is entirely cut through, it is removed by grasping with the beaks of the tool.

This safety opener is made of steel drop forgings which have been hardened and tempered.

Vacuum Still for Solvent Reclamation

Hills and Morrow, Mishawaka, Indiana, are the designers of a steam heated vacuum still, used for the reclamation and maintenance of critical solvents, and the separation of oils, fats, tallows, etc. from solvents used in extraction processes.

The "Hilmor" Type "K" Vacuum Still, as this equipment is called, is especially adapted to any plant in which naphtha, gasoline, benzol, toluol, kerosene, mineral spirits, oleum spirits, V. P. M. naphtha, alcohols and lacquer thinners are available for reclamation.

Vacuum still used for solvent reclamation.

In cases in which the solvent is heavily contaminated, the large residue capacity of the "K" model is necessary to the efficient reclamation of the solvent.

Standard models range up to 400 gallons per hour capacity, and special designs are available for special duties.

"Hilmor" stills are automatic and continuous in operation, requiring a minimum of attendance. The reclaimed solvents are restored to their full efficiency and can be used repeatedly for their original purposes, thereby effecting substantial economies in solvent processes, both through the drastic reduction of solvent purchases, and by virtue of uniform efficiency, systematically maintained.

Professional Directory

Platers Technical Service Co.
Electroplating and Chemical Engineers
Complete services, including solution analyses, process development and deposit tests.
S. C. Taormina ..... Tech. Director
Dr. C. B. F. Young ..... Tech. Advisor
Dr. G. Amorosi ..... Engr. Advisor
(Professional Engineer)
59 E. 4th St., N. Y. C. ORchard 4-1778

C. B. HOGABOOM JR. & CO.
Consulting Chemical Engineers
SALT SPRAY TESTING — CERTIFIED TO MEET ARMY AND NAVY SPECIFICATIONS. Testing of deposits-thickness, composition, porosity. Solution analyses, plant design, process development.
44 East Kinney St. Newark, N. J.

Joseph B. Kushner, Ch.E.
Metal Finishing Consultant
Plating plants streamlined for defense work.
233 W. 26th St., N. Y. C.

WYANDOTTE *Service* Representative is the name, and now more than ever the emphasis is on the service.

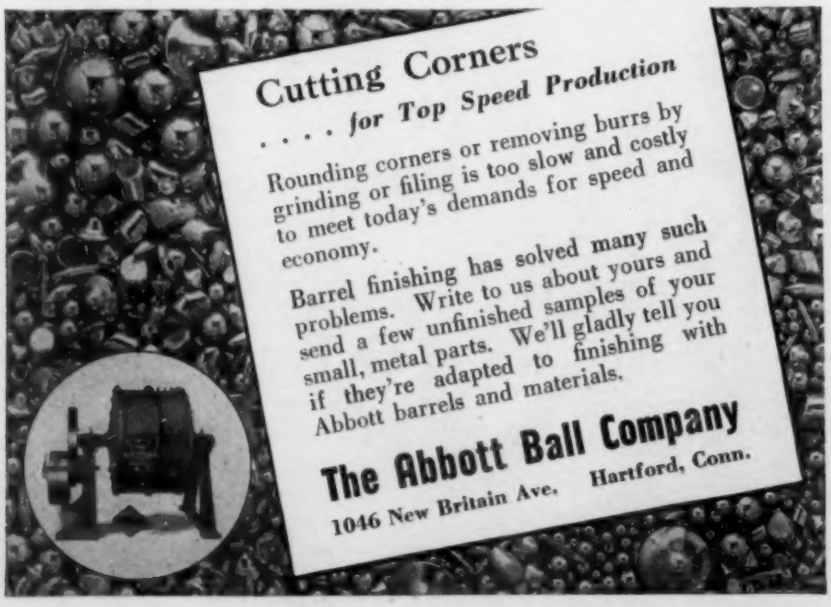
Service to you in your big job of serving the nation. Service any time night and day. Service at once, when you need it, and as long as you need it.

Wyandotte Service Representatives are trained metal-cleaning experts. They work in war production plants and arsenals the country over, and they are constantly bumping into and pushing over all kinds of metal cleaning and finishing problems, old and new, large and small.

Whether you are cleaning ammunition, plane or tank parts—whatever your degreasing problem may be—there's a Wyandotte man at your shoulder, ready to help you do the job . . . ready to do it right and right away!

Wyandotte
PRODUCTS
SERVICE REPRESENTATIVES IN 88 CITIES

THE J. B. FORD SALES COMPANY • WYANDOTTE, MICHIGAN


Cutting Corners
. . . . for Top Speed Production
Rounding corners or removing burrs by grinding or filing is too slow and costly to meet today's demands for speed and economy.
Barrel finishing has solved many such problems. Write to us about yours and send a few unfinished samples of your small, metal parts. We'll gladly tell you if they're adapted to finishing with Abbott barrels and materials.
The Abbott Ball Company
1046 New Britain Ave. Hartford, Conn.

Agent for Bright Pickling

The Hanson-Van Winkle-Munning Company of Matawan, New Jersey, have announced the development of a new type product called "Surbrite" which is a free-running powder prepared in two types for addition to hydrochloric and sulfuric acid pickles.

Its use in small quantities in the regular acid pickles is stated to enable the production of bright, smut-free surfaces when iron and steel are pickled. In some cases, such as in the pickling of castings, the finish may appear dull as if overpickled, thus hiding the brightening effect. The agents are stated to reduce acid consumption and metal loss in comparison with pickling where plain acid is used inasmuch as the agents are claimed to be excellent inhibitors. The use of the product is therefore also claimed to avoid smut formation and excessive etching and to allow much easier control of pickling particularly when using hydrochloric acid.

The agent is supplied in two forms. One form is called "Surbrite H" which is recommended for use in hydrochloric acid pickles. The other form is called "Surbrite S" and it is for use in sulfuric acid pickles.

The use of the product involves stirring the material, which is in the form of a powder, into the acid solution. The amount to be added is roughly ½ per cent by weight of the acid used. In the case of pickling with hot sulfuric acid solutions, a somewhat greater amount than ½ per cent by weight of the acid may be required when the temperature is above 160°F.

The company states that in cases where the inhibitor adheres to the surface of the steel causing poor adherence of plated finishes, this difficulty can be obviated by making the work the anode in one of the company's cleaners. Literature is available from the company describing this new development.

Manufacturers' Literature

Alkaline Copper Processes for Selective Hardening and Deep-Drawing of Steel

United Chromium, Inc., 51 East 42nd Street, New York City has issued an informative 6-page leaflet, Bulletin No. 56, describing the "Unichrome" Alkaline Copper Plating Process.

This leaflet explains why the characteristics of this process are particularly valuable in deep-drawing of steel parts, where a ductile, adherent coating of copper is required to act as a lubricant between the work and the drawing dies. It also outlines how the dense, fine-grained deposits which this process produces are a valuable aid in selective carburizing of gears, shafts, and other steel parts.

In addition, Bulletin No. 56 announces the Unichrome Alkaline Stripping Bath in which copper coatings can be readily removed at

speeds up to 0.001" in 10 minutes or less, without any effect on the steel base metal.

Copies are available upon request from the company.

Buffing, Burring, Polishing and Lapping Compounds

Formax Manufacturing Company, 3999 18th Street, Detroit, Mich., have published a 12-page loose-leaf catalogue section under the serial No. FB42 describing their buffing, burring, polishing and lapping compounds. This section is illustrated and is printed in two colors.

A chart is given which gives speed figures and types of buffs and compounds recommended for both the cutting down process and the coloring operation. Another chart gives the r.p.m. speed to be expected from 2"-20" wheels.

The company's greaseless compounds, burring compounds for use on tampico wheels and buffing compounds are presented as well as details of their color compounds, white lime finish, stainless steel compositions, pumice grease sticks, glue, etc.

Hydrogenated Rosin

Staybelite Resin, the hydrogenated rosin produced by Hercules Powder Company, Wilmington, Del., from the southern pine, is discussed in a new, eight-page booklet just issued by the Naval Stores Department of the chemical firm.

Physical and chemical properties of the resin are set forth in the analysis of a typical sample, and major properties are also discussed generally. Certain solvents and plasticizers for the resin are cited.

Graphs indicating the rate of oxygen absorption of Staybelite as compared with the rate for WW gum rosin and N wood resin, and indicating the oxygen demand of regular rosin size versus Staybelite size, are presented. Miscibility characteristics of the resin with typical organic solids, and compatibility of waxes with it, are listed in tables.

Among the applications for Staybelite discussed are its use in adhesives, rubber compounding, resin manufacture, rubber reclaiming, the electrical industry, paper size, paper converting, greases and lubricants, ceramics, soaps, and metallic resinates.

Staybelite has also found application in beer-can solder fluxes because of its decreased odor and taste characteristics. It is also being used in other specialty solder fluxes. Other fields in which the resin is now used or is being investigated embrace the manufacture of printing inks, plastics, caulking mastics, linoleum waxes, battery seals, optical lens pitch, brewer's pitch, box toes, rock wool, cordage.

The booklet explains that Staybelite Resin is produced by a continuous, closely controlled, almost automatic high-pressure catalytic hydrogenation process. Physically, Staybelite Resin is a glass-clear, pale amber, non-hygroscopic solid with a softening point slightly below that of regular rosin. Chemically, the resin retains the full acidity and most of the other distinctive properties of rosin, except for a degree of saturation with hydrogen which substantially increases its resistance to embrittlement and discoloration on exposure to oxygen or ultraviolet light.

Polishing Wheels

Formax Manufacturing Company, 3999 18th Street, Detroit Mich., have just published an 8-page catalogue section under the serial No. FW43.

This loose-leaf booklet is printed in two colors and is adequately illustrated with various buffing and polishing wheels including, among others, wire, muslin, felt and tampico types. In addition, the booklet contains a chart suggesting the proper wheels to be used for the four polishing operations involved in finishing such metals as aluminum, brass, cast iron, etc.

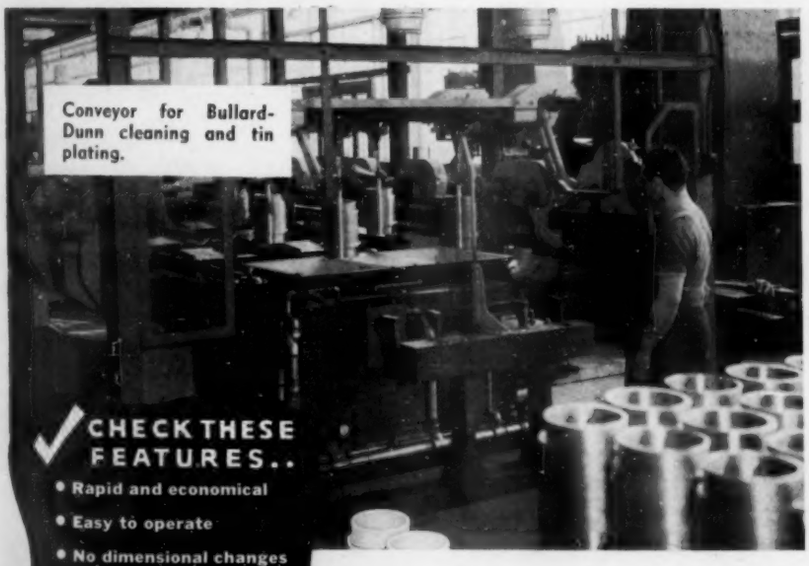
Salt Baths

Park Chemical Company, 8074-8110 Military Avenue, Detroit, Mich., have issued Bulletin No. 100 dealing with salt baths for steel. This bulletin is available upon request from the company.

It is an illustrated, two-color folder of six pages and it features specifications for heat treating in salt baths for high speed steel.

Neutral salt baths and salt baths for reheating and "light" cyanide cases are also discussed.

How BULLARD-DUNN Process *makes* BETTER Enqines



✓CHECK THESE FEATURES..

- Rapid and economical
- Easy to operate
- No dimensional changes
- No etching
- Descales recesses
- Produces chemically clean surfaces
- Can be fully conveyorized
- Long solution life

BULLARD-DUNN *Process*

THE BULLARD-DUNN PROCESS DIVISION OF THE BULLARD COMPANY, BRIDGEPORT, CONN., U. S. A.

● One of the country's biggest airplane engine builders has installed this equipment to utilize the Bullard-Dunn Process for cleaning engine cylinders prior to tin plating for heat treat stop-off. Bullard-Dunn provides the perfect preparation that is needed for this important job.

This is only one of many ways and many types of installations by which the Bullard-Dunn Process is being used by America's leading industries to help build better military products. In addition, this process simplifies descaling operations and speeds up production, so essential to the war effort. Ask for booklet and engineering estimates on your work.

★ **Cowles PC Cleaner** has shortened and simplified operations and is producing desired results in the aviation industry. **Cowles PC Cleaner** can be regulated to etch an aluminum surface in any degree from a mirror light "no-etch" to a caustic etch for painting, without subsequent pitting after hours of exposure.

In less than a minute of total immersion time, the aluminum is cleaned, degreased, stripped of all anodic film and ready for spot welding.

There is no formation of "cement" coating around tanks and heating coils.

If you are cleaning aluminum for spot welding or any other purpose, write for our recommendations.

THE COWLES DETERGENT CO.
7016 EUCLID AVE. METAL CLEANING DEPT. CLEVELAND, OHIO

RANSOHOFF

WE'RE ALL PARTNERS NOW IN ONE GREAT, BIG JOB

Metal Cleaning
EQUIPMENT

. . . that's the job that RANSOHOFF CLEANING EQUIPMENT tackles and licks to a finish. 'Round the clock and 'round the nation this equipment is cutting time lags and production costs. For example, machine illustrated washes and rinses cartridge parts.

N. RANSOHOFF, Inc.
TOWNSHIP AND BIG 4 RR,
CINCINNATI, O.

Let Ransohoff Engineers figure out how to lick your cleaning problem. Drop us a line.

Sanitation Manual

Oakite Products, Inc., 18 Thames Street, New York City, are the publishers of a new, 16-page illustrated manual which discusses war-time sanitary measures and "good housekeeping" routines for use in steel mills, foundries, etc. It tells how Oakite Deodorant No. 1, a recently developed 3-purpose material, cleans, deodorizes and disinfects cement, porcelain, metal, tile and wood surfaces in a single operation. The manual contains tested recommendations for maintaining sanitary conditions. Free copies of the booklet are available from the company.

Soft Rubber Polishing Wheels

Formax Manufacturing Company, 3999 18th Street, Detroit, Mich., have published a two-colored illustrated sheet, under the serial No. FR44, describing their soft rubber polishing wheels. This sheet is perforated for loose-leaf insertion and gives data on the wheels as well as on the types of bond, polishing sticks and mandrels available.

Scale and Rust Removal

Oakite Products, Inc., 18 Thames Street, New York City, have recently issued a revised edition of their manual entitled "Oakite Compound No. 32" which deals with the cleaning and de-scaling of water-cooled or water-circulating equipment.

This 24-page booklet describes methods for safely and effectively removing lime-scale, rust and similar deposits from a wide range of equipment to maintain normal heat transfer capacity or to effect other results essential to greater operating efficiency. Among the units discussed are metal washing machines, cutting and quenching oil cooling coils, spot welding machines, blast furnace cooling coils, Diesel cooling systems, lubricating oil and jacket-water coolers, refrigerant condensers and compressors, feedwater heaters and surface condensers.

Of interest from the production point of view are the data on removing mill scale and other scale deposits from heat treated, hardened, annealed or welded parts or surfaces before subsequent finishing operations; and also on removing rust from parts between manufacturing or assembly operations and from exterior surfaces of machinery or equipment for maintenance purposes.

Copies of this illustrated manual are available upon request.

Technical Publications

Steel Products Manual. Carbon Steel Sheets. Section 11. American Iron and Steel Institute, 350 Fifth Ave., New York City. June 1942. Price 25c, post paid.

Supplementary National Emergency Steels NE 9400, 9500 *and* 9600 *Series.* Contributions to the Metallurgy of Steel, No. 8. American Iron and Steel Institute, 350 Fifth Avenue, New York City, September, 1942. 89 pps. Price: 25c.

Part I contains data on supplementary national emergency steels. These data include composition, heat treatment information and relationships between "Standard Steels" and "National Emergency Steels".

Part II gives further information on physical properties and hardenability.

Part III discusses limitations on alloying elements and also contains many drawings to illustrate physical property data. Relationships between tensile strength and hardness are shown.

Part IV contains standard end-quench hardenability curves.

The National Emergency Steels NE 8000 Series. Contributions to the Metallurgy of Steel, No. 7. American Iron and Steel Institute, 350 Fifth Avenue, New York City, August, 1942. 50 pps. Price: 25c.

This booklet details the composition and comparative physical properties of the National Emergency Steels. It has copious chart and graph data and deals generously with hardenability characteristics of the various types discussed.

A bibliography of selected references on hardenability testing is included.

Handbook Of Special Steels. Allegheny Ludlum Steel Corporation. Pittsburgh, Pa. 1942. 127 pps. Available on request.

This revised edition of the "Handbook of Special Steels" which incorporates all pertinent information on the various grades of stainless, tool and other special alloy steels, has just been issued.

It includes complete data for guidance in the proper selection, treatment and use of these alloy steels, with finder charts and plenty of tables to facilitate reference.

Tool steels are discussed with suggestions for selecting the proper grades. Appended is a table setting forth recommended types for particular applications.

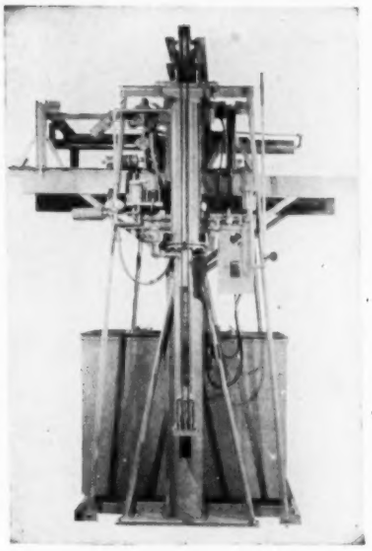
A large section of the book is given over to charts dealing with steel weights and with sizes of flats and numerous other shapes.

Machining Alcoa Aluminum And Its Alloys. Published by The Aluminum Company of America, Pittsburgh, Pennsylvania, 1942. Size 5¼" x 8¼"; 43 pages. Copies of this booklet may be secured free of charge by writing to the Aluminum Company of America, Pittsburgh, Pennsylvania.

The booklet sets forth the general principles of machining aluminum and its alloys, suggests speeds, feeds, and depths of cut which will produce satisfactory results; points out where practices and tools common to other metals may be used; and indicates where special practices or tools are desirable. Part 1 deals with general machine shop practice. Part 2 describes the practices employed in automatic screw machine operations.

Heat Transfer Through Metallic Walls. International Nickel Co., 67 Wall St., New York, N. Y. This 16-page booklet from data prepared by the Development & Research Division of the International Nickel Co., includes information in formulae for determining overall heat transfer rates, the various factors influencing heat transfer through metallic walls, and the thermal conductivities of metals and alloys commonly used in the construction of process equipment. To the original data there have been added a number of illustrations showing several

Crown Pick-up Unit



...MACHINE...

A UNIT TYPE TRANSFER CAPABLE OF HANDLING SEVERAL TANKS AT ONE TIME.

•

...USE...

FOR A SERIES OF OPERATIONS WHERE THE WORK MUST PASS THROUGH SEVERAL TANKS, AS THE CLEANING AND RINSING OPERATIONS, FOR A SEMI-AUTOMATIC PLATING TANK.

CROWN RHEOSTAT & SUPPLY CO.
1910 MAYPOLE AVENUE :-: :-: CHICAGO, ILLINOIS

Speed up your war orders with

BLACK-MAGIC

"The one-bath process"

Only 40% of the time and 40% of the cost of any two-bath process and we guarantee equal penetration and better rust-proofing.

BLACK-MAGIC is approved for many Government operations.

Write for portfolio of complete information on Black-Magic and its related products.

THE MITCHELL-BRADFORD CHEMICAL CO.
BRIDGEPORT, CONN.

Distributors

A. R. Purdy Co. Inc., New York City
Universal Paint & Varnish Co., Cleveland, Ohio
Henry Steinhaus Co., Milwaukee, Wis.
Knight Research & Mfg. Co., Buffalo, N. Y.
Clarence Gush, 1218 Olive St., St. Louis, Mo.
A. J. Walch, 35 E. Wacker Drive, Chicago, Ill.
Lea Manufacturing Co., Waterbury, Conn.
Wm. H. Price, Jr. (Divisional Mgr.), 2908 Rising Sun Rd., Ardmore, Pa.

CHROMIC Acid

99.75% PURE

With two complete, independent plants at Jersey City and Baltimore, and its own supply of the basic raw material Chrome Ore from company owned and operated mines, Mutual is the world's foremost manufacturer of Chromic Acid.

BICHROMATE OF SODA
BICHROMATE OF POTASH

Mutual Chemical Co of America
270 MADISON AVENUE, NEW YORK

MUTUAL CHEMICAL CO. OF AMERICA — MUTUAL — NEW YORK, N.Y.

UNPARALLELED UNIFORMITY
AS WITH HARRISON'S 4A PRODUCTS

FOR GETTING MORE WORK FROM YOUR GRAIN USE

4A CEMENT and THINNER
A Substitute For Glue

NO WORRY ABOUT GLUE SHORTAGE WITH 4A CEMENT AND THINNER. Polishing wheels are free cutting, long lasting and economical when set up with 4A Cement.

COLORING ROUGES UNIFORM, CAREFULLY GRADED RAW MATERIALS, EXPERTLY COMPOUNDED BY HARRISON'S TECHNICIANS, INSURE ROUGES THAT GIVE HIGH LUSTER AND FAULTLESS FINISHES.

POLISHING COMPOUNDS 4A symbolizes these four features which you require for high speed polishing, mirror finishing of all kinds of steel, including stainless steel, carbon steels and hard-to-buff alloys. Use it on any kind of a wheel, soft, medium or hard.

Tell us your problem and samples of compounds, rouges or cement will be sent.
We will be pleased to recommend proper methods.

"AMPLE STOCKS TO TAKE CARE OF OUR TRADE"

4A HARRISON and COMPANY
Haverhill, Mass.

types of equipment which are characteristic of process units that depend on the transfer of heat through metallic walls for normal operations.

Cadmium Poisoning. Prepared by Division of Industrial Hygiene, National Institute of Health, U. S. Public Health Service. For sale by Superintendent of Documents, Washington, D. C. Price: 5 cents. 12 pps. 1942.

This booklet reviews the history and incidence of cadmium poisoning and considers prevention measures. Sections are devoted to the occurrence and practical uses of the metal, its physico-chemical properties, tests for determining its presence, industrial exposure data, experimental reports and symptoms of cadmium poisoning by ingestion and respiration.

How to Use Truing and Dressing Tools for Better Grinding. Published by the Norton Company, Worcester, Mass. 20 pps.

This 5 in. by 7 in. booklet is completely illustrated with photographs and drawings showing different variations of the four general types of wheel dressers: mechanical (revolving metal cutters), abrasive wheel, abrasive stick and diamond.

New Books

Introduction to Electrochemistry. By Samuel Glasstone. Published by D. Van Nostrand Co., Inc., 250 4th Ave., New York. Size 9¼" x 6¼"; 545 pages. Price $5.00.

The object of this book is to provide an introduction to the modern viewpoints of electrochemistry and the text is of value chiefly to those possessing a good background in chemistry and mathematics.

It should prove to be an excellent text to enable the chemist and physicist to learn the fundamentals of electrochemistry. The newer concepts of the subject are treated at length including the activity concept, the interionic attraction theory, the proton-transfer theory of acids and bases, and the consideration of electrode reactions as rate processes.

The contents are as follows: Electrolytic Conductance, The Theory of Electrolytic Conductance, The Migration of Ions, Free Energy and Activity, Reversible Cells, Electrode Potentials, Oxidation-Reduction Systems, Acids and Bases, The Determination of Hydrogen Ions, Neutralization and Hydrolysis, Amphoteric Electrolytes, Polarization and Overvoltage, The Deposition and Corrosion of Metals, Electrolytic Oxidation and Reduction, Electrokinetic Phenomena.

Certain sections of the book should prove to be of interest to the analytical chemist.

The breakdown of subject matter under the head of "The Deposition and Corrosion of Metals" is as follows: Physical Nature of Electrodeposited Metals; I. Current Density; II. Concentration of Electrolyte; III. Temperature; IV. Colloidal Matter; V. Electrolyte; VI. Basis Metal; Throwing Power; Simultaneous Discharge of Cations; Depolarization of Metal Deposition; Separation of

Metals by Electrolysis; Electrochemical Passivity; Passivity and Current Density; Chemical Passivity; Theories of Passivity; Mechanical Passivity; The Corrosion of Metals; Hydrogen Evolution Type; Corrosion in Presence of a Depolarizer; Differential Oxygenation Corrosion.

Procedure Handbook of Arc Welding Design and Practice. Seventh Edition. Published by Lincoln Electric Co., Cleveland, Ohio. Size 9" x 6"; 1252 pages. Price $1.50.

This book is particularly timely in view of the extremely widespread use of welding processes in production of war equipment. New information in the seventh edition has been given on the following subjects: Welding Methods and Equipment; Technique of Welding; Procedures, Speeds and Costs; Fleet-Fillet Technique; Weld Metal and Methods of Testing; Weldability of Metals; Welded Steel Construction—Machine Design; Designing of Arc-Welded Structures; Typical Applications of Arc Welding in Manufacturing, Construction and Maintenance; Reference Data.

The chapter on "Weldability of Metals" is particularly good. In this paper the welding characteristics as well as certain metallurgical features are discussed for almost all of the metal alloys to be plated.

The book is profusely illustrated with charts, graphs, schematic drawings and photographs to augment the clearly written text.

Fatigue of Metals: Some Facts for the Designing Engineer. Second Edition. By D. Landau. Published by The Nitralloy Corp., 230 Park Ave., New York. Size 9" x 6"; 88 pages. Free of charge.

The first edition of this booklet contained 45 pages and was published just about a year ago, and this second edition is more than twice the size of the first edition.

The subject of fatigue is particularly important to the design engineer, who has to deal with the high speed "engines" of war production. The introduction to the book gives a readily understood description of the meaning of fatigue and the mechanism of the same.

The subject of stress is treated at length. Also included is a discussion of the various machines for measuring fatigue and typical calculations. A bibliography of seventy references is appended.

TIN RESEARCH REPORT

In the Tin Research Institute's Report for 1941 it is stated that since Japan began the Far Eastern campaign the main problem has become one of how to make the best use of the supplies available, by curtailing the use of tin in commodities not essential to the war effort; by improving the processes in essential uses, and by recovering tin.

For these tasks, the experience accumulated by the Institute is invaluable, and it has been appointed by the Ministry of Supply to advise on all technical questions affecting the use of tin.

During 1941 the major efforts of the Tin Research Institute were concentrated with war problems, on which it is not possible to report in detail. The Institute has assisted the Ministry of Food and the Ministry

Speed ACID PICKLING the DOUBLY SURE* Way with Enthone Acid Addition Agent

★ FASTER PICKLING — the acid rapidly penetrates under rust and scale, thus LIFTING THEM OFF!

★ SAVES ACID — Drag-out is materially reduced and acid is saved by inhibiting action.

OVERCOMES WATER-BREAK IN PICKLING — Due to poor alkaline cleaning or soap in the alkaline cleaner, water-breaks appear on acid dipping before plating. The use of ENTHONE AAA in the acid literally makes the acid a cleaner and overcomes peeling due to faulty cleaning.

Write today for FREE Trial SAMPLE and valuable informative BULLETIN

THE Enthone COMPANY
NEW HAVEN CONNECTICUT

BRING YOUR PROBLEMS TO
FINISHING HEADQUARTERS

McAleer is the source for **all** types of finishing materials. McAleer has laboratory facilities and technicians to solve special problems—develop new compounds.

Headquarters for sanding, rubbing and buffing compounds, tripoli, grease stick, rouge, white finish, emery cake and paste.

Distributors Valencia Pumice
Powdered and Lump

McALEER MANUFACTURING COMPANY
ROCHESTER, MICHIGAN

• CHEMICAL RESISTING EQUIPMENT •

Electroplating & Metal Pickling

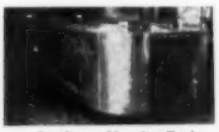
PROCESS TANKS

Chrome Plating—Lead lined

Chrome Plating—Ceramic Brick lined

Pickle Tank—Sulphuric

Plast-O-Line Lined Tank Muriatic Pickle



Anodic or Alumilite Tank Lead Fume Hood

SOMETHING BETTER IN

TANKS

Plain or Lined with
Ceramic Brick - Carbon Brick
Plastic - Monel - Lead
Flex-A-Prene Synthetic Rubber

Chromium Plating
Nickel Plating
Copper Plating
Nickel Dip
Anodizing
Phosphorizing
Sulphuric—Muriatic
Stainless Pickle

TANK HEATERS

Coils
Steam Jets
Gas Immerison
Electric Units

Heat Exchangers

Nocorodal Carbon Heaters

ACID & ALKALI PROOF MATERIALS

Plast-O-Line Tank Lining
Hot Applied
(Sold in bulk)
Carbalt Plastic
Cold Applied
(Sold in drums)

LEAD ANODES

HEIL SAWTOOTH
Flat
Special shapes

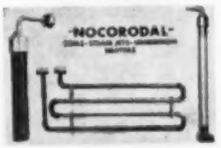
WRITE FOR DETAILS

HEATING UNITS

Steam Coils—Agitating Steam Jets

Gas Immersion Unit Acid Dip

Electric Immersion Lead—Steel—Carbon



Nocorodal Heaters for Muriatic and Stainless Pickle

Monel Dump Basket for Pickling

HEIL ENGINEERING COMPANY

12901 ELMWOOD AVE. CLEVELAND, OHIO

PRINTED IN U. S. A.

A NEW NICKEL STRIPPING PROCESS USING

STRIPODE

(Patent applied for)

An inhibiting agent for Sulphuric Acid strip baths that—

PREVENTS PITTING AND ROUGHENING OF THE BASE METAL

(Steel, brass, zinc die castings, heavy zinc and lead bearing alloys)

STRIPODE

Reduces Finishing Costs to a Minimum
Reduces Stripping Time by 50% or More in Many Cases
Reduces Your Scrap Loss
Strips Plating Racks
Saves Acid

Write for information and literature

CHEMICAL CORPORATION **93 Broad Street**

SPRINGFIELD, MASSACHUSETTS

of Supply in finding a substitute for cereal products used to remove palm oil from freshly made tinplates. Progress has been made in developing a substitute for the palm oil, which is now in short supply.

The Institute's hot-tinning plant was in continuous operation throughout the year, and much assistance was rendered to manufacturers in tinning some kinds of steel which have hitherto been difficult to tin.

Collaboration with manufacturers and with Government departments in the application of electrotinning for parts of armaments was continued during the year, and there has also been considerable interest in electrotinning for small soldering tags, terminals and clips. Although not dealt with in the Report, the most important application of this work will soon be seen in the production of specially thinly coated tinplates, as a war economy measure, requiring only one third of the tin used on normal tinplate.

Other sections of the Report review the progress made in research on tin-rich bearing alloys, foil and bronzes. Copies may be obtained free of charge from the Tin Research Institute, Fraser Road, Greenford, Middlesex.

Machine Tools at Work. By Charles O. Herb. Published by The Industrial Press, 148 Lafayette St., New York. Size 6" x 9"; 544 pages; 434 illustrations. Price $4.00.

This book, as its title indicates, deals throughout with machine tools in action, and shows actual examples of shop practice. These examples have been carefully selected from the best equipped shops in the United States to illustrate a wide range of applications of modern machine tools. The 434 illustrations show outstanding jobs from all types of machine-building plants. These illustrations represent jobs on a large variety of the most modern types of machine tools, such as are used for turning, drilling, milling, planing, grinding, broaching, etc.

Clear, close-up views show not only the actual machining operations, but the tooling, work-holding, and other auxiliary equipment. These views are all accompanied by the main facts about each job, with specific data on speeds, feeds, production rates, etc., in many cases.

The book is intended not only to supplement the shop or school course, but also to provide the machine shop executive or production manager with a general work of reference covering the practice in many classes of thoroughly modern shops. The examples of work selected and the types of machines and tool equipment used, illustrate principles and methods that are applicable to many other classes of work.

Physics for Engineers. By Sir Ambrose Fleming. 1942. Published by Chemical Publishing Co., Inc., Brooklyn, N. Y. Size 8¾" x 5¾"; 228 pages. Price $3.00.

A practical survey of present-day knowledge in the realm of physics written with special reference to the requirements of engineers.

The author has both excellent practical and technical knowledge.

Contents are as follows: Fundamental Physical Units; Matter and Electricity; Forms of Energy and Equivalents; Energy

Transformations; Fundamental Principles of Electrostatics and Electro-Magnetism; The Production of Electric Currents; Systems of Electric Measurement; Electric Measuring Instruments; Thermionic and Photo-Electric Emission; Technical Applications of Electronic Emission; Radiation and the Quantum Theory; Electron Optics and Wave Theory of Matter; Sound, Music, and Telephony; Alternating Electric Currents and Supersonic Vibrations; Atomic Transformations.

Journal of the Institute of Metals. Edited by N. B. Vaughan. Volume LXVII, 1941. Demy 8vo. Pp. 380, with 46 plates and numerous illustrations in the text. London: The Institute of Metals, 4 Grosvenor Gardens, S.W.1. (£2 net or, with *Metallurgical Abstracts*, Vol. VIII, 1941, £4).

The volume contains, bound together, the 25 papers that appeared in the monthly issues of the *Journal* of the Institute of Metals during 1941, together with discussions on a number of them, and an abridged text of the Institute's May Lecture: "The Significance of Low-Temperature Research," by Dr. F. Simon. The papers, all of which incorporate the results of original research, range widely over the field of non-ferrous metallurgy. Of interest to foundrymen are two eminently practical papers: "Causes of Porosity in Tin-Bronze Castings," by T. F. Pearson and W. A. Baker, and "Unsoundness in Gravity Die-Cast Silicon-Aluminum Alloy Pistons," by R. T. Parker. Two papers important to those engaged in the aircraft industry are "The Rolling of a Magnesium Alloy," by W. R. D. Jones and L. Powell, and "Quenching Stresses in Aluminum Alloys," by A. von Zeerleder. Then there is a group of three papers dealing with X-ray studies of the structures of cold-rolled metals; two are on magnesium alloy by D. E. Thomas and L. Frommer, respectively, while the third, on copper, is by Maurice Cook and T. L. Richards, who have made previous important contributions in this field of knowledge. In another paper Dr. Cook (with W. G. Tallis) places on record valuable data on "The Physical Properties and Annealing Characteristics of Standard Phosphor-Bronze Alloys." The volume contains reports of several investigations into the constitution of various binary and ternary alloy systems, notably two on ternary aluminum systems by H. W. L. Phillips. Finally, there is a full description of a novel method of measuring the surface hardness of metals which has been devised by Bruce Chalmers, and which has already excited considerable discussion.

Associations and Societies

American Electroplaters' Society

Fall Meeting, Rochester, Buffalo, and Toronto Branches

The three above-mentioned branches will hold an educational session and banquet on

HARD CHROMIUM PLATING

By The Reverse Current Method

U. S. Patent No. 1,645,927

Defense production, where every minute counts, has been quick to realize the advantages of hard chromium plating. The chromium is electroplated directly onto the steel base metal, thereby eliminating the necessity for all copper and nickel plating. In the matter of time-saving and uniformly satisfactory results there is no substitute for the reverse current method of hard plating with chromium—the hardest of all metals.

Write us for information about the licensing arrangement on this process, which is covered by our U. S. Patent No. 1,645,927.

Metals Protection Corporation

RUST PROOF · NON-CORROSIVE · CHROMILITE PROCESSES · PERMANENT · FINISHES

Union Tile Building, Indianapolis, Indiana

McKeon's

"Liquid Sulphur"

TRADE MARK REG'D

STRIPS COPPER

after

SELECTIVE CARBURIZING

SULPHUR PRODUCTS CO. Greensburg, Pa.

(Service? Sure.)

Saturday, October 24th, at the General Brock Hotel in Niagara Falls, Ontario. The educational session will start at 2 p.m. The speakers and the subjects of their talks will be: *William M. Phillips*, General Motors Corporation, Detroit, Mich., "Bright Copper Plating from Acid Solutions" and *Arthur Logozzo*, Hartford Chromium Corporation, Hartford, Conn., "Cleaning Preparatory to Hard Chromium Plating".

In the evening a dinner will be held at 7 p.m. followed by dancing at 10 p.m. During the afternoon the ladies will be served tea in the Rainbow Room and facilities for playing bridge will be provided.

Price: $2.50 per person; dancing $1.00 per person.

Los Angeles Branch

Manuel Sanz, process engineer of Vultee Aircraft Co., and winner of last year's national convention prize for the best paper appearing in the *Monthly Review*, was the guest of honor and principal speaker at the first fall meeting of Los Angeles Branch, A.E.S., at the Rosslyn Hotel, September 9.

Mr. Sanz was formally presented with the $50 check awarded by the supreme society for his paper "Chromic Acid Baths for Anodizing or Chromatizing Aluminum or Its Alloys," which appeared in the September 4, 1941, issue of the *Monthly Review*.

Announcement that Mr. Sanz would again address the branch on a timely airplane plant subject attracted the year's largest attendance. Members and guests from Douglas, Timm Aircraft, Vultee, Hughes Aircraft Co. and Lockheed Aircraft Co. were present.

Mr. Sanz delivered an extemporaneous talk on "Identifying Aluminum and Stainless Steel by Simple Spot Test." He discussed surface preparation of steel used in aircraft and gave an outline of plywood and steel substitutes for aluminum in training planes, and various problems which had to be met with steel coming into wider use.

The most serious problem in the use of steel for airplane assemblies, he said, is corrosion in seams with outdoor exposure. The speaker then discussed various treatments available for treating steel sheets to assure against corrosion, remove grease and clean prior to spot welding. In this connection, he touched upon dipping in bonderized solution. Automobile manufacturers, he declared, have been using the bonderized treatment with a manganese and copper sulphate solution. The bonderized treatment, now used by the Vultee Aircraft Co., is also appliable to zinc, Mr. Sanz said.

A tribute to the late *William J. R. Kennedy* was read into the minutes by *Ernest Lamoreux*, after which the membership stood in silent tribute to the late supreme secretary for one minute.

The applications for membership of *Fred L. Ferguson* and *James B. Houston* were received and referred to the board of managers for action.

"MICCRO" COATING MATERIALS
Meet NEW Requirements
for Effective
PROTECTION of BASKETS
Used In Washing
and Pickling Processes

Until recently, baskets used in carrying parts through processes of alkali washing, petroleum spirits or emulsion cleaning, and pickling have been manufactured of special alloy steels which were impervious to the solutions used. Today, these alloys are not available, and baskets must be made of ordinary metals which show quick deterioration unless protected by a coating material.

The use of Miccro Supreme Stop-Off Lacquers and Miccrolite provides the most effective and economical method of protecting metal baskets. In addition to offering unequalled resistance to the various solutions, these coating materials also resist the abrasive effects of loading the basket with metal parts or the wear to which they may be subjected on certain types of conveyors.

Miccro coating materials can be quickly and easily applied in your own plant. Or, if you prefer, we now have facilities available to handle the work for you . . . efficiently and at moderate cost. WRITE FOR FULL DETAILS.

Developed and Manufactured By Experienced Platers

MICHIGAN CHROME & CHEMICAL CO.
348 EAST JEFFERSON · DETROIT, MICHIGAN

Annual Picnic

The pressure of war emergencies and changing panorama of economics in the metal finishing field has not dampened the ardor and enthusiasm of Los Angeles electroplaters to any appreciable degree, as was shown by an attendance of some 60 or 70 persons at the annual picnic of Los Angeles Branch, A.E.S., on Sunday, July 26.

Business may be slack and metals scarce, but no evidence of this was apparent as the branch members, their families and friends gave themselves up to the enjoyment of an al fresco basket lunch outing in City Park, Montebello, Calif.

Old familiar faces, laughter and conviviality all came out to harmonize with pleasant weather and a program for which the responsible committees are to be highly commended. General chairman was the always-efficient *Erwin Frauenhoff*, vice-president of the branch, who was assisted by *E. S. Wells, Stanley Rynkofs, John Merigold, C. C. McLaren* and *E. R. Holman*, branch president.

Highlight of the afternoon was a series of contests and races which the committee chose to fit the physical abilities of old and young, thin and obese. Secretary-Treasurer *Carroll McLaren* seemed to enjoy the games more than the contestants as he galloped around the park.

Biggest laugh producer was a so-called "Stick-and-Turn Race", in which two teams of five competed. The contestants were supposed to dash from their home base, one at a time, to a three foot upright pole, bow their heads on their hands on top of the pole, turn around eight times, and then try to find their way to home base. Eight revolutions around the pole made some of the contestants dizzy enough to stumble about like headless chickens, much to the amusement of the onlookers.

Winners of the men's division in this contest were *Stanley Rynkofs, James ApRoberts, Erwin Frauenhoff, Lester Belger* and *M. Biederman*. Of the women's division: *Betty Vasquez, Ann Sloan, Mrs. Stanley Rynkofs, Mrs. Keith Brown* and *Mrs. Jean Vasquez*.

Winners (in order of finish) in other races were: Sack Race: *Jack Hart, Keith Brown, James ApRoberts.*

Shoe Kicking: *Mrs. Jack Hart, Mrs. Pet Berry, Ardith Biederman.*

Two-legged Race: *Lester Belger-Mrs. Ann Sloan; Mr.* and *Mrs. Stanley Rynkofs; Mr.* and *Mrs. E. R. Holman.*

Girls Race: *Barbara Ann Sloan, Ardith Biederman, Joan Wells.*

Boys Race: *Guy Biederman, John Wilms, Bud Frauenhoff.*

Peanut Race: *Ann Sloan, Mary Biederman, Mrs. Stanley Rynkofs.*

Men's Distance Race: *Dick Luke, Lester Belger, Stanley Rynkofs* and *Ray Vasquez.*

Business Items

Detroit Rackote Company Becomes Division of Wyandotte Paint Products Company

It was recently announced that the Detroit Rackote Company has become a division of the Wyandotte Paint Products Company, Wyandotte, Mich. The Detroit Rackote Company was engaged in the sale and service of insulation materials and stop-off lacquers used in the finishing industry and after the death of the company's president, Mr. E. M. Mead, it was decided that better service to the industry could result from a consolidation of the Detroit Rackote Company and the Wyandotte Paint Products Company inasmuch as the latter company has developed and manufactured the products.

Under the new set-up, it is planned to sell Rackote insulation materials and stop-off lacquers on a national basis through reputable plating supply companies.

The company has available a booklet describing its various insulation products.

R. A. Schoenfeld, vice president and sales manager for *Wheelco Instruments Co.,* Chicago, has announced three appointments to the company's sales and service organization. *C. L. Clark,* of Westinghouse Electric & Manufacturing Co. for the past 13 years—recently as control specialist at the Cincinnati office—has been assigned to the Cleveland office as sales engineer. *Robert N. Miller,* for the past seven years sales and service engineer for Mercoid Corporation in Chicago, is now service engineer with the Wheelco Cleveland office. *Howard B Jones,* formerly with McGraw-Hill Publishing Co., has been employed as sales and service engineer at the Chicago office.

J. B. Ford Sales Co. Employees Honored

The employees of *The J. B. Ford Sales Company* are proudly displaying a U. S. Treasury Department Bullseye Flag at their Wyandotte, Michigan, headquarters, and smaller Bullseye Banners in each of their 23 territory offices. This Bullseye Award was made because 99 72/100% of the Ford Sales Company employees are subscribing 10.4% of their monthly salaries to War Bonds. Five of the territory offices of the Wyandotte organization exceed 12% in their purchase of bonds; the Cleveland office being "tops" with 14.5%.

Pictured above is W. F. Torrey, Vice-President of both The J. B. Ford Sales Company and Michigan Alkali Company, receiving the U. S. Treasury Bullseye Flag from Dick LeClair, Wyandotte, Michigan boy, who was wounded 47 times at Pearl Harbor.

Use the **PERMAG** PROCESS

Cleaning Metals prior to Finishing

Metal parts must be clean to produce the proper finish. Avoid rejects. Finishing is a vital operation. Cleaning before finishing is equally as vital. Hence, the question, What Cleaner shall be used? Our customers will tell you, PERMAG Compounds give quicker, more efficient service. **Plants turning out war materials where fast production is imperative, use the PERMAG process.**

If you've a cleaning problem, our cooperative service based on years of knowledge and experience will help you. Write us. No obligation involved.

Manufacturers of Specialized Scientific Cleaning Compounds for Industrial Purposes.

MAGNUSON PRODUCTS CORPORATION

Representatives from Coast to Coast. Warehouses in principal cities of U. S. In Canada: Canadian Permag Products, Ltd., Montreal-Toronto.

Main Office: 50 Court St., BROOKLYN, N. Y.

Faster Production — Lower Cost with this Return Type Wash Rinse and Drying Machine

This type of machine has operated for years in various manufacturing plants, cleaning screw machine parts related to mass production. It is now used for war essentials and is adapted for cleaning fuse parts and artillery components.

Write for details on metal cleaning equipment.

- Exceptionally large production capacity.
- One man operated.
- Work is placed in trays.

Other War Equipment Manufactured by METALWASH MACHINERY CO.

—Artillery Cartridge Case Spray Pickling and Processing Machines for brass and steel cases.
—Mouth and Taper Anneal and Treatment Processing Machines for brass and steel cases.
—Bonderizing Machines for steel artillery cases.
—Projectile Machines.
—Projectile Quenching Machines.

METALWASH MACHINERY CO.
149-155 Shaw Avenue Irvington, N. J.

COMPLETE DUST PROTECTION
FOR EVERY METAL FINISHING JOB
(U. S. Bureau of Mines-Approved)

the M·S·A Comfo RESPIRATOR

WITH PLASTIC FILTER CONTAINERS

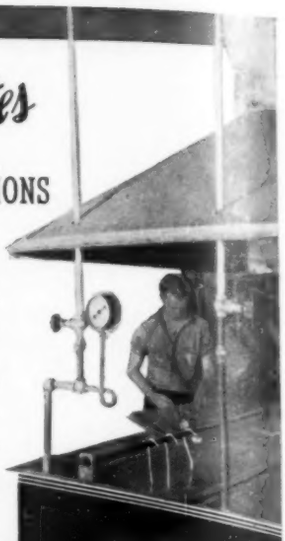
Now designed with metal-saving all-plastic filter containers, this husky U. S. Bureau-of-Mines-approved respirator offers top safety, comfort and durability in service, *plus* lower breathing resistance—better sidewise and downward vision—high impact strength—no electrical conductivity. Flexible, easy fitting facepiece is simple to clean and keep clean. Write for Bulletin CR-9 today!

THE "ALL-DUST" FILTER
Interchangeable, easily replaceable M.S.A. "All-Dust" Single Filters give you assurance of protection against *each and every one* of your dust hazards, whether pneumoconiosis-producing, nuisance or toxic dusts.

Demonstrations Gladly Arranged on Request

MINE SAFETY APPLIANCES CO.
BRADDOCK, THOMAS and MEADE STREETS
PITTSBURGH, PA.

Good Electrolytes
METSO CLEANING SOLUTIONS



RAPID cleaning calls for solutions of high conductivity, and here again Metso Cleaners serve the electroplater efficiently. Not only is high conductivity obtainable, but stability under high current density as well.

These benefits plus chemically clean surfaces influence leading platers to specify "METSO".

It's the soluble silica (SiO_2) content in all Metso Cleaners that aids in the quick removal of dirt and prevents redeposition on the clean work. Write for further information.

PHILADELPHIA QUARTZ COMPANY
General Offices: 125 S. Third St., Phila., Pa.
Chicago Sales Office: 205 W. Wacker Drive
Stocks in over 60 Cities

METSO CLEANERS
•
METSO GRANULAR
METSO 66 · METSO 99
SODIUM METASILICATE
SODIUM SESQUISILICATE

METSO CLEANERS

There's a FORMAX Answer for Every Burring Problem: . . .

FORMAX Burring Compounds
(It Really Sticks to Tampico Wheels!)
Here, at last, is a buffing compound that "stays put" long enough to do an efficient job!

GREASLESS COMPOUNDS
Developed for burring, polishing, trimming, breaking sharp corners, removing machine tool marks, etc.

SOFT RUBBER POLISHING WHEELS
They contain an abrasive that is compounded in an elastic rubber binder. Produces an entirely different finish than a grind or buff. Removes file marks, digs, burrs, sharp corners, heat marks. Cleans welded and soldered joints. De-burrs light stampings, castings and machined parts.

FORMAX
COMPOUNDS AND POLISHING WHEELS

FREE! Three New and Important Folders. Send for them TODAY!

FORMAX MFG. COMPANY
3999 18th St., DETROIT, MICH.

Francis Boyer Elected Director of Penn Salt

At a meeting of the Board of Directors of the *Pennsylvania Salt Manufacturing Company* on Aug. 19, *Francis Boyer* was elected a director to fill the vacancy resulting from the death of *Samuel D. Warriner* on April 3.

Mr. Boyer is Executive Vice President and Director of the Smith, Kline & French Laboratories of Philadelphia. He was born in Penllyn, Pennsylvania and is a resident of Plymouth Meeting, Pennsylvania.

Herbert D. Schmidt, formerly New England Representative of the American Hard Rubber Co., has just become affiliated with the Sales Dept. of *The United States Stoneware Co.* He will make his headquarters in their New York Office, specializing in the sale of "Tygon",—the synthetic rubber-like material for tank linings, flexible tubing, gasketing, molded and extruded shapes, etc. Mr. Schmidt has had a background of fifteen years experience in the chemical equipment industry.

R. L. Cain, who for the past year served as a priority specialist for *Westvaco Chlorine Products Corporation*, has joined the general sales department of *Pennsylvania Salt Manufacturing Company*, Philadelphia, in the heavy chemicals division. He was previously in charge of sales and service for Westvaco in New York City and at the same time served as divisional sales manager of the Curtin-Howe Corporation, Westvaco affiliate.

William H. Slavin, controller of the *Hanson-Van Winkle-Munning Co.*, Matawan, N. J., has been elected to active membership in the Controllers Institute of America, a technical and professional organization of controllers devoted to improvement of controllership procedure.

California News

By Fred A. Herr

Douglas Aircraft Co. has greatly expanded its program of using government trainees in the plating and polishing departments of its plants. The firm began using a small number of young men supplied by Government employment agencies about a year ago for on-the-job training in various phases of metal finishing in anticipation of possible shortages of trained workmen as the national defense program expanded.

Demand for finishing shop help is so acute at present that the company now has approximately 60 young men in training. They are given apprenticeship training under experienced platers and polishers during the first month. Used first on wire-up work and similar tasks, they are advanced to more important jobs as their progress warrants and eventually receive practical experience at the tanks. Youths who show no aptitude for the work are eliminated after the first month. Foremen of the various metal finishing and treating departments handle the instruction personally.

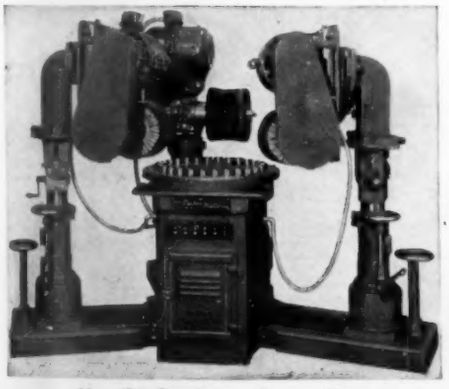
Herold J. Kroesche, formerly sales engineer with *A. J. Lynch Co.*, and *H. C. White*, Los Angeles attorney, have formed the *Catalyctic Chemical Co.* and have established offices in the Richfield Building, Los Angeles. Kroesche returned early in September from a three months business trip to the middlewest and east during which he made contacts with manufacturers and distributors in St. Louis, Buffalo, New York and other cities.

E. W. Wells of the Los Angeles branch of *Chas. F. L'Hommedieu & Sons Co.*, returned September 6 from a three weeks business trip to the middlewest, during which he visited the Chicago office of his firm as well as the Industrial Lubricating Co., Detroit, Mich.

William Schulo, Jr., formerly superintendent of the plating room at *Bendix Aviation, Ltd.'s* plant, has assumed new duties as assistant process engineer with *National Aircraft Equipment Co.*

National Aircraft, which formerly job-shopped its metal finishing work, has just completed installation of facilities for doing its own finishing and heat treating. The firm makes hydraulic assemblies and other plane parts for Lockheed and other Southern California airplane manufacturers.

•AUTOMATICALLY
POLISHING & BUFFING

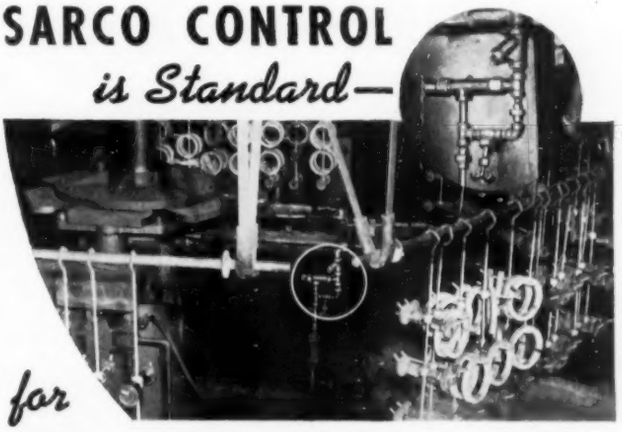


No. 424 Continuous Rotary Type

There's a PACKER-MATIC for your requirements — ROTARY — STRAIGHT LINE CONVEYOR — ROLL Types. Literature available.

•AUTOMATIC POLISHING & BUFFING MACHINES
Packer-Matic
THE PACKER MACHINE CO., MERIDEN, CONN., U. S. A.

SARCO CONTROL
is Standard—

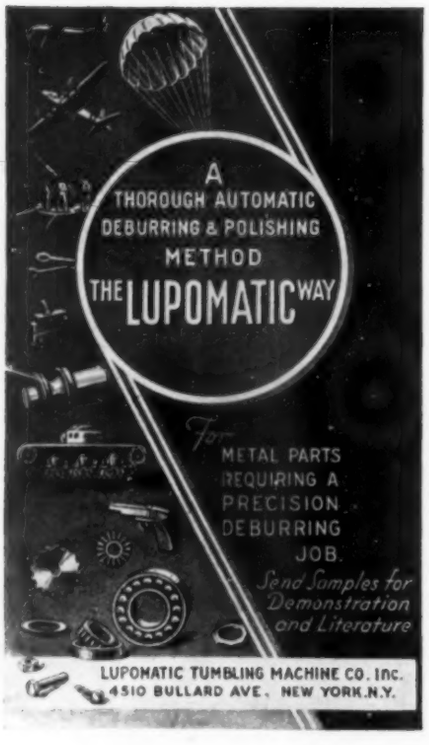


for
BULLARD-DUNN PROCESS

The photograph above shows a typical Bullard-Dunn Process unit using a Sarco Thermoton for temperature regulation. The Bullard-Dunn Process removes scale and oxide completely from steel surfaces without etching. It cleans out recesses as well as flat surfaces. These are the reasons it is being used so widely in the manufacture of airplane engines, machine guns, tank transmissions, aircraft bearings, aviation instruments and the like. Sarco is proud to share in this important war work by keeping the Bullard-Dunn baths at their most efficient operating temperatures.

162

SARCO SAVES STEAM
SARCO COMPANY, INC.
475 Fifth Avenue, New York, N. Y.
Sarco Canada Ltd., Federal Bldg., Toronto, Ont.



FOR

HARD CHROMIUM

USE

ZIALITE

ADDITION AGENTS

to obtain

1. Finer grain structure
2. More durable plate
3. Smoother heavy plate
4. Greater throwing power
5. Less sensitivity to sulphate ratio.

Send a sample of your present bath to see if it is suitable for conversion to this improved formula.

ZIALITE CORPORATION
143 Exchange Street
Worcester, Mass.

INSULATED PLATING RACKS

Special and Standard Sizes

For all parts regardless of shape. We specialize in your rack problem.

STANDARD PLATING RACK CO.
1925 N. Paulina St.
Chicago, Ill.
ARMITAGE 6766

B. G. Daw, president, *Lasalco, Inc.*, St. Louis, Mo., was a September visitor to Los Angeles. He attended the first fall meeting of Los Angeles Branch, A.E.S., on September 9, where he renewed the many friendships he had made at the annual educational session in March at which he delivered two of the outstanding talks.

Gene Rynkofs, 19, a plater in the *Liberty Plating Co.* operated at Los Angeles by his father, *Marcus Rynkofs*, past-president of Los Angeles A.E.S., has enlisted in the Marines and is receiving his preliminary training at the San Diego, Calif., Marine Base.

Al Perkins, L. M. Butcher Co., Los Angeles, has rejoined the Navy for the duration. A former Navy man, Perkins went in on a chief's rating.

Sam T. Hayward and *E. H. Baller* have established the *General Sandblasting Co.* at Los Angeles.

Metallurgists Wanted in the War Program

In the mobilization of manpower for the civilian war service of the Government there is a continuing call for scientifically and technically trained men and women. Among those urgently needed are metallurgists for work in connection with specific problems in the field of metallurgy—problems connected with some phase of the War Program.

The Civil Service Commission is recruiting metallurgists under two new examinations recently announced: Announcement No. 238 for positions paying $2,600 to $5,600 and Announcement No. 254 for junior grade positions paying $2,000.

The requirements of the examinations have been modified and college teaching in metallurgy is now accepted as professional experience.

For the higher grade positions ($2,600 to $5,600) the requirements now are: completion of a four-year course with major study in metallurgy or closely allied subjects and a minimum of two years of professional experience (which may include college teaching) in metallurgy. Additional experience will be required for the higher grades.

For the junior grade positions ($2,000), the requirements are: (1) completion of a four-year college course in metallurgy or metallurgical engineering; or (2) completion of a four-year course in an allied subject supplemented by (a) one year of paid experience in metallurgy (which may include college teaching), or (b) 15 semester hours in metallurgy or metallurgical engineering, or (c) two War Training Courses in metallurgy. Applications will be accepted from college senior or graduate students who expect to complete the required courses within 6 months after filing applications.

Applications will be accepted until the needs of the service have been met. There are no age limits for these examinations. No written test is required.

Announcements and application forms may be obtained at any first- or second-class post office or from the Civil Service Commission, Washington, D. C.

VULCAN SODIUM STANNATE

Manufactured by

THE VULCAN DETINNING CO.
SEWAREN, N. J.

Under Patents Nos. 1,575,217 and 1,708,392

FOR TIN ELECTROPLATING

SALES AGENT

The R. & H. Chemicals Dep't, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

HECCO BRAND EMERY

Made from the highest quality selected ores obtainable in this country and in the same careful and thorough manner as imported emeries.

These rough-surfaced solid shaped grains hold unusually well in the glue.

Write for full details.

HAMILTON
EMERY & CORUNDUM CO.
Chester Mass.

BRASS SHEET
Bronze and Gilding
Processed For Difficult Drawing
Bright Finishes
ROD - WIRE
BRISTOL, CONNECTICUT
Offices:
15 Park Row, NEW YORK
Hospital Trust Building, PROVIDENCE, R. I.

A Complete Line of Requirements for the Electroplating Industry

MUNNING

MUNNING & MUNNING, Inc.
Manufacturers of Electroplating, Buffing, Polishing Apparatus and Supplies.
202-208 Emmet St. Newark, N. J.
Branch Offices: New York, Philadelphia, Woonsocket, R. I.